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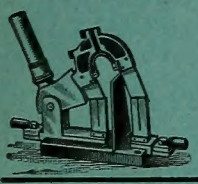

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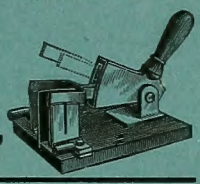

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Westinghouse Electric and Mfg. Co. ..... ——
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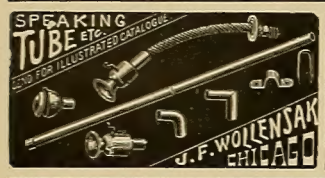

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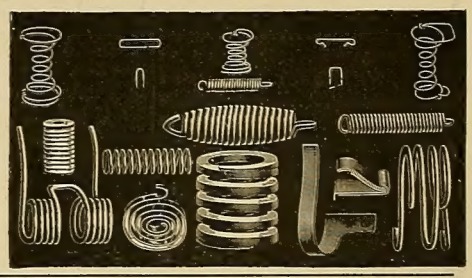

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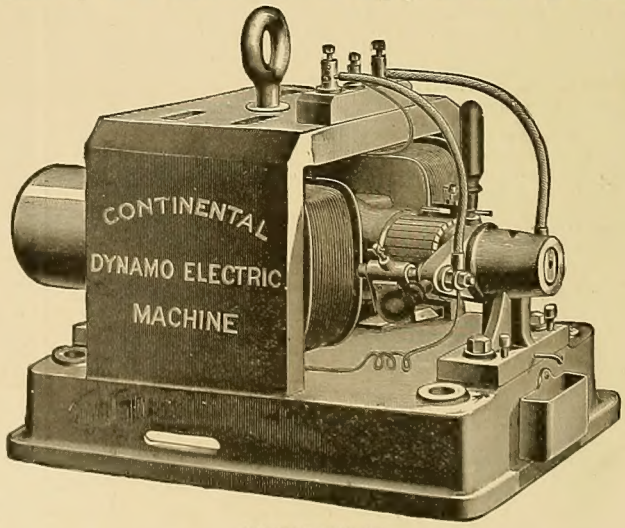

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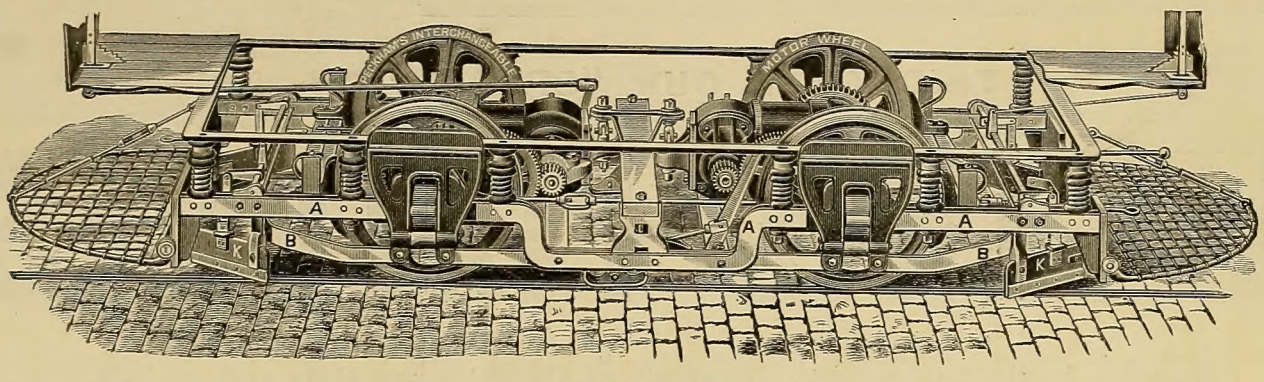

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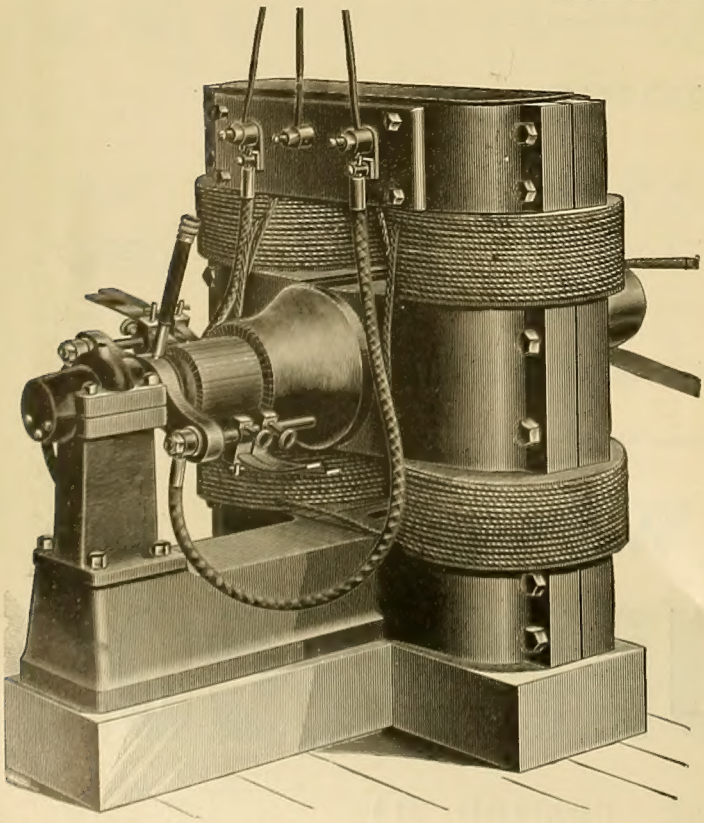

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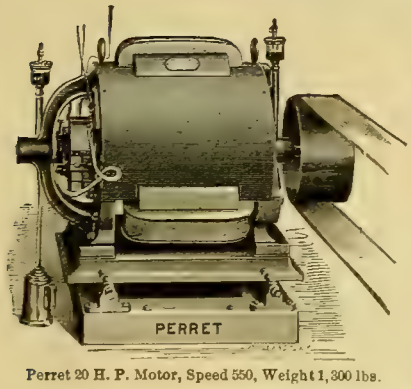

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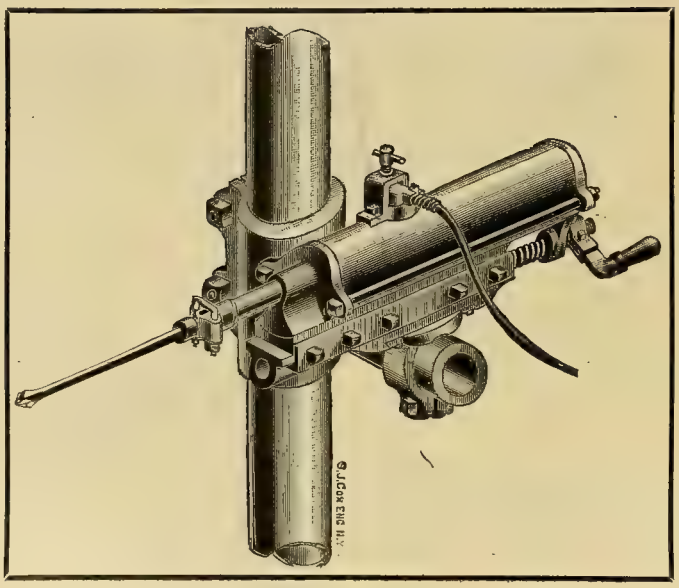

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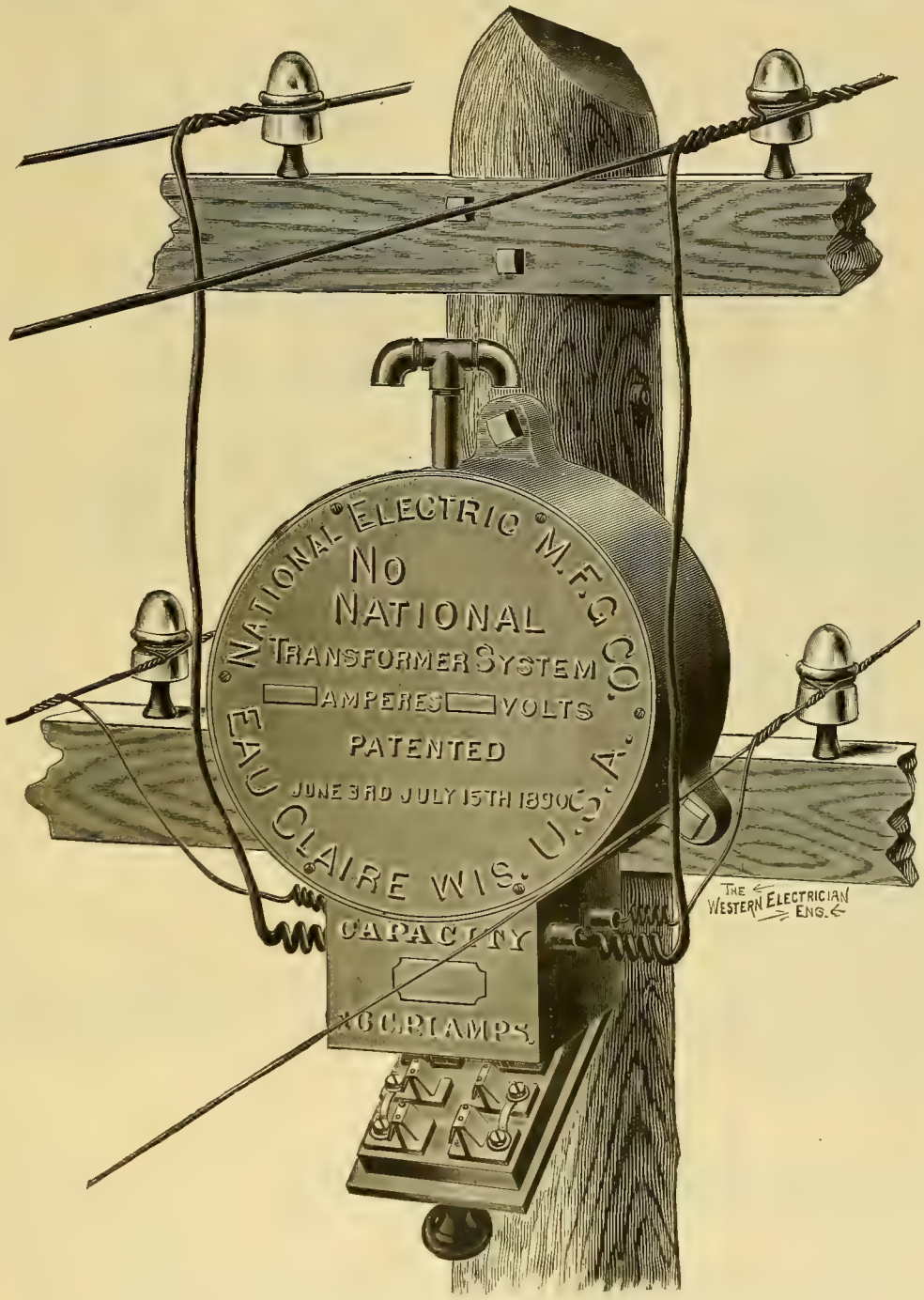

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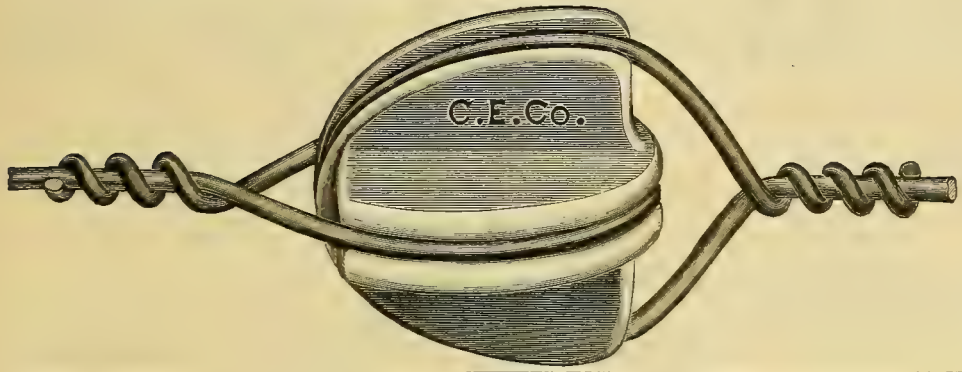

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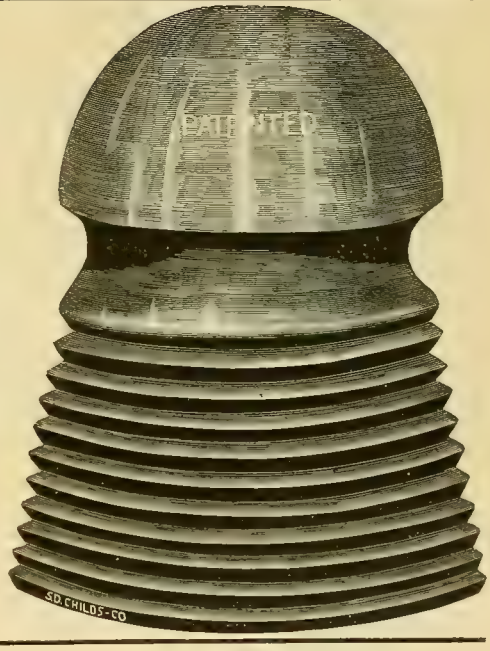

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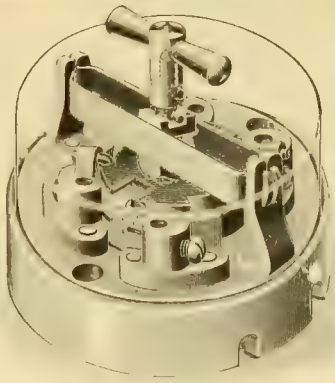

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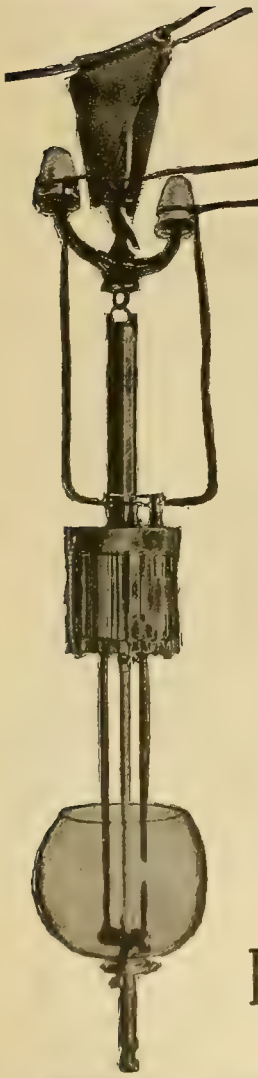

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Lamp insulated from hanger.

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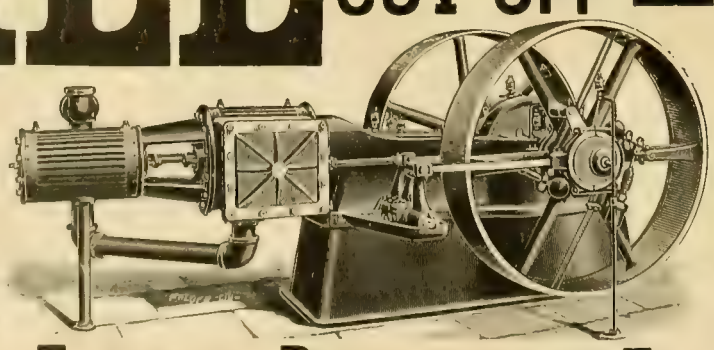

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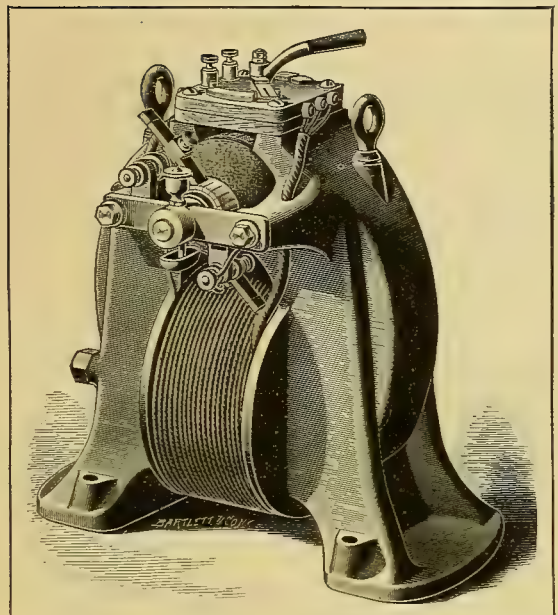

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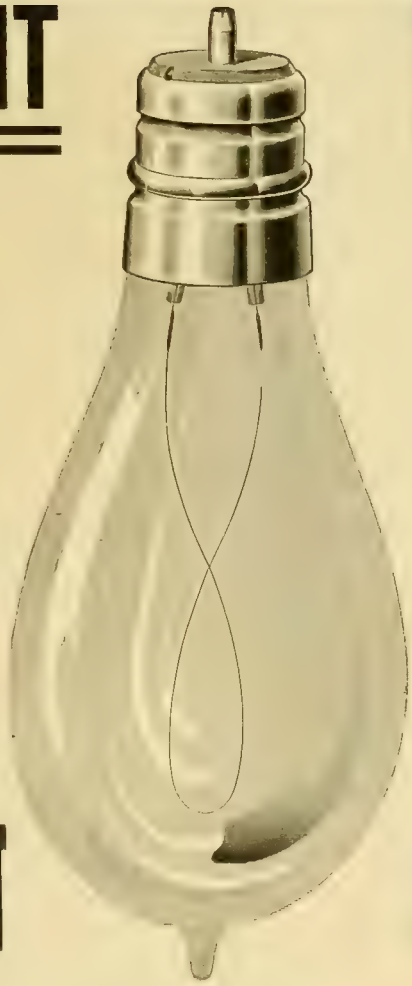

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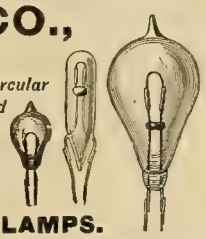

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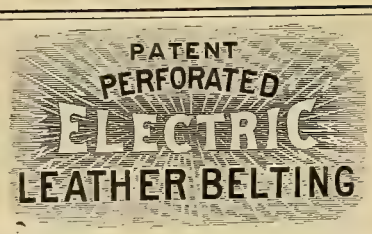

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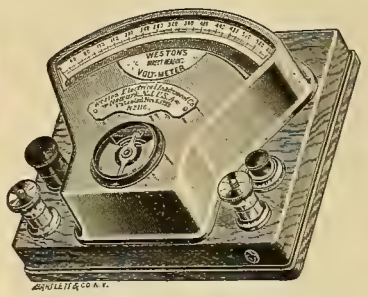

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Western Electrician.

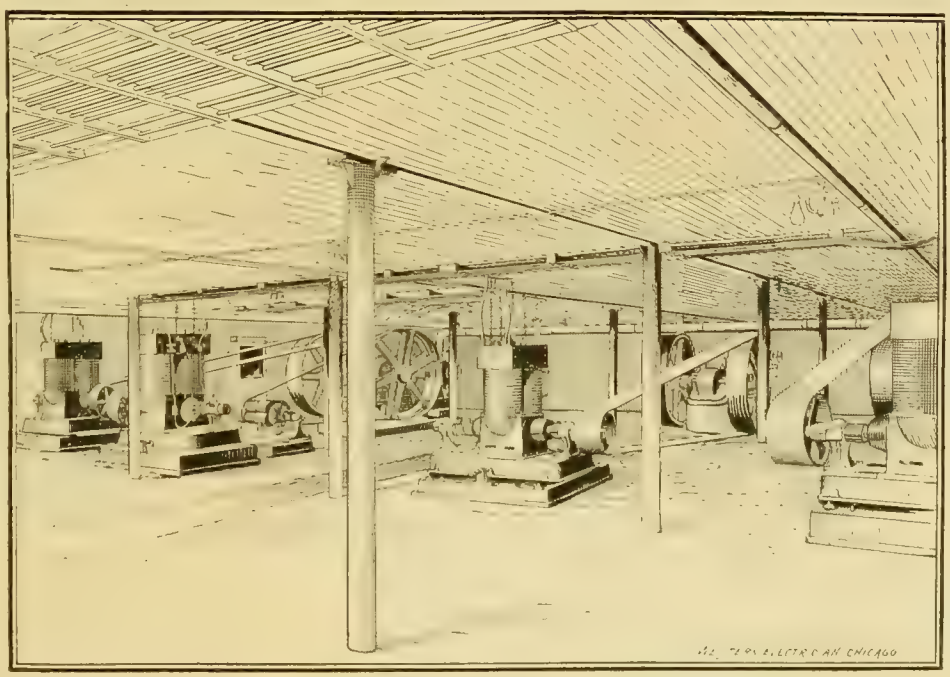
EVERY SATURDAY.

Vol. VIII. CHICAGO, JANUARY 3, 1891. No. 1

Edison Plant at the Grand Central Passenger Station, Chicago.

On the evening of December 8th the Grand Central Passenger Station, Chicago, was formally opened to the public. The foundations for this building were commenced in October, 1887, when it was decided to establish the Wisconsin Central headquarters there, but the plans have been materially changed several times—the enterprise assuming greater proportions on each occasion, until to-day provision is made for the Chicago & Northern Pacific, Chicago, St. Paul & Kansas City, and the Baltimore & Ohio railroads, as well as the Wisconsin Central.

One of the most interesting features of the new structure is the lighting plant, which is located in the basement of the building, and is beneath the spacious driveway. The illustrations show the dynamo room and the main switchboard. The electrical equipment consists of five Edison incandescent dynamos and two Sperry arc machines. Of the Edison machines four are of 900 lights capacity each, and one is of 720 lights capacity. The Sperry machines are 30 lighters. The station was wired for 4,300 16 candle power lamps. In the train shed there are 336 32 candle power lamps arranged in clusters. These lights are so wired that they may be lighted in 10 sections from the dispatcher's office. In this way the shed may be illuminated according to the position of any particular train. The south and north arch of the train shed are each illuminated by 90 32 candle power lamps. The driveway takes an additional 60 32 candle power lamps. There are 600 lamps in the freight department, 200 in the express offices and the remainder are distributed about the railroad offices and waiting rooms. Eleven of the arc lamps are arranged about the entrances in front of the building, and six are distributed about the train shed.



EDISON PLANT AT THE GRAND CENTRAL PASSENGER STATION, CHICAGO.

The steam plant consists of two 300-horse-power Hazleton upright boilers, and three McIntosh & Seymour engines. The engines are compound, and are of 100, 150 and 250-horse-power, respectively.

The plant was planned by Prof. F. B. Badt. The work was carried out under the personal supervision of G. D. Hand.

Chicago Electric Club.

The first of the Chicago Electric club parties was given at the club rooms on the evening of December 26. About seventy-five members and friends were present. The club rooms were decorated with evergreens and were brilliantly illuminated with electric lights. The guests began to assemble about half after eight. The dancing was commenced in Kinsley's ball room, which adjoins the club rooms, at nine, and was continued until after midnight. The german was led by W. J. Buckley.

Chicago City Electric Light Plant.

The new city electric light plant at the corner of Fourteenth street and Indiana aveuue, Chicago, was operated for the first time on Christmas evening. It had been hoped that the entire number of street lamps to be furnished with current from this station would be operated, but owing to delays of contractors only about eighty lights illuminated the south side district. All the dynamos are of the Western Electric company's manufacture. Two hundred high tension and 180 low tension lamps will be operated. Two engines which have been used in one of the old city plants are used; one is a Wright engine of 250-horse power, and the other is a Buckeye engine of 125-horse power.

In October last, Mayor Cregier of Chicago, in a message to the city council, made a number of suggestions which he thought, if adopted, would advance the interests of the municipality. Among the number was the following: "A system of public heating, public electric or gas lighting, both for street or house service, and a system of pneumatic tubes for mail and other service, and also underground ducts for smoke." It is apparent that this suggestion contemplates the extension of the municipal electric light service, so that the city will engage in commercial lighting in competition with existing companies. A committee of influential Chicagoans which was appointed by the council to consider the suggestions of the mayor, met last week. After considering the several propositions, the members approved them without exception and decided to take steps to ascertain what legislation was needed to enable the city to carry them into practical effect. It was rather surprising that representative business men of Chicago would give their approval to a project of this kind the purpose of which is to establish a service in direct competition with established industries.

The committee also decided to ask the heads of all city departments what changes or modifications they deemed advisability to make their departments more effective. Prof. Barrett, as the head of the city electrical department, will recommend the extension of the fire alarm service and the city electric lighting system to the towns which have been annexed to Chicago within the last year.

Alleged Primary Battery Swindlers.

C. D. Covell was arrested at Council Bluffs, Ia., last week on the charge of obtaining money by false pretenses. About a month ago two men who gave their names as C. D. Covell and W. Bellard rented a building in Council Bluffs and represented that they desired to interest capitalists in a scheme of electric lighting which was bound to revolutionize modern methods of illumination. As the story is told in the charge against Covell, it is the old tale of the primary battery swindle. According to the complainants the defendant said he had a battery which cost only a few dollars to make. When it was filled with proper chemicals at a cost of 60 cents it would run twelve incandescent lights for seven hours each night and a small motor for six hours each day for a period of seven months. It was explained, it is alleged, that the battery could be put into every house in the country where the owner had the ability to pay $90, and then the company that was to be organized would make a clean $80 on each one. The projectors wanted to organize a stock company and for this purpose would place $10,000 worth of stock at 50 cents on the dollar.

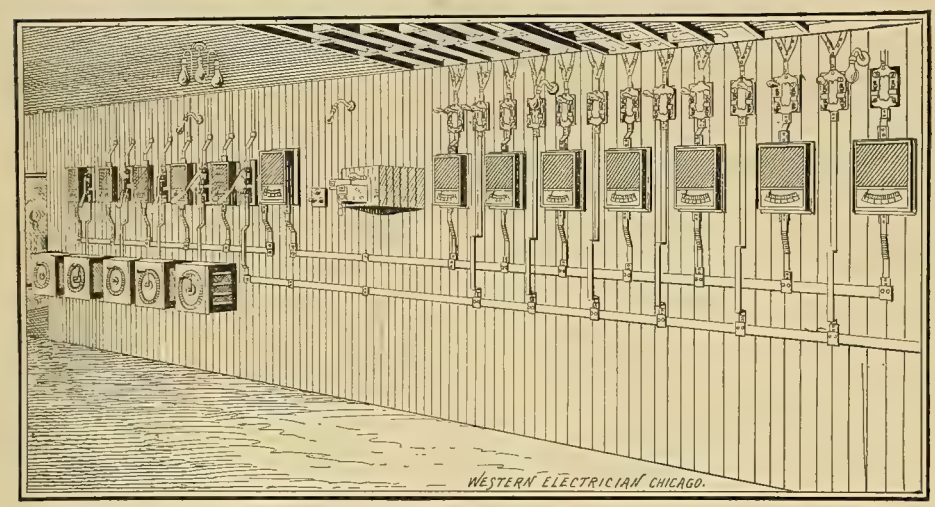
A number of exhibitions were made which were inspected with great interest. A dozen incandescent lights which lighted an appartment obtained their current, apparently, from an ordinary looking cell in the exhibition room. One resident of the city was so delighted with the system of illumination that he contributed to the capital stock. It was subsequently learned, according to the complaint, that the current came not from the cells which were exhibited, but from a set of accumulators which had been located in an out-of-the-way corner. The storage batteries were taken from their hiding place in the morning, so the story goes, and were charged at an electric light station. When this fact was ascertained the contributor to the capital stock promptly instituted proceedings and one of the principals was arrested. He denies that his scheme was a swindling project, but alleges, with vehemence, that his batteries will do all he has claimed.

A dispatch from Casey, Ill., says. "The Postal Telegraph company, which placed a line of poles through this city some weeks since along the National road, and in so doing topped many of the choice shade trees along that thoroughfare, has been asked to pay $200 damages by the city council. It appears no compromise has been effected. In view of this state of affairs, the council held a meeting last week and ordered the poles removed. The following day about half were taken up that were inside the corporate limits. The balance will be removed soon.

Electrical Department of the World's Fair.

In previous numbers of the WESTERN ELECTRICIAN the immediate organization of the electrical department of the World's Fair has been urged. The *Evening Post* of Chicago has been working along the same line. In a recent issue it gives in an interview the opinion of a gen leman "who is at the head of one of the big electrical houses." The gentleman in question, after speaking of the necessity of united action among electrical men, says:

"To look after all these things, then, to help form all sorts of desirable combinations for the execution of gigantic schemes to encourage desirable exhibitors, to keep out undesirable ones, to allot the proper amount of space to each according to desert; in a word, to sum up the great problem of what the Chicago World's Fair electrical exhibit should be and to work intelligently toward accomplishing the greatest possible result, there should be an electrician named for the head of the bureau at once. His work for several months would need to be only supervisory and the place only an honorable one without pay, but for a dozen other reasons than those I have given he ought to be appointed at once. Not an inconsiderable one among these reasons is the jealousy that exists between the various interests. There is more of it than among doctors. These people are waiting now to see who is going to be appointed. Suppose some electric light man from one of the companies should be appointed, all the other lighting men would say, 'Well, we'll have no show there,' and would not be disposed to exhibit. I only speak of this as a reason for an early appointment; I am very sure that the criticism will not be heard after the appointment, for I happen to know Colonel Davis personally, and he will not make the mistake of appointing a party whose interests will be a part of the exhibit. By all means advocate an immediate appointment of an electrical head."

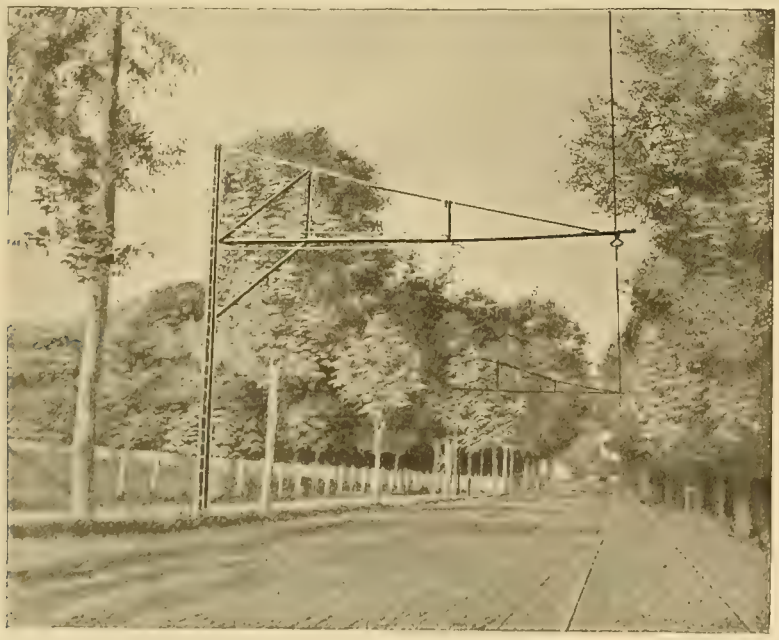


EDISON PLANT AT THE GRAND CENTRAL PASSENGER STATION, CHICAGO—SWITCH-BOARD.

The Largest Electric Railway Poles.

The cut gives a view of part of the Passaic, Clifton & Garfield railway at Passaic, N. J. The four poles which are used on this section of the road are said to be the largest used for electric railway work in the world. The track is located on one side of the street and as some of the property owners objected to placing poles on the curb line the railway company was compelled to set the poles on the opposite side of the street, and throw an arm entirely across.

The facts were stated to Milliken Bros., of New York, who were left to design and execute the work. There were many serious difficulties to contend with in supporting and bracing an arm of such length on a single pole without the use of guy wires from the pole to the ground. The firm's usual form of pole was used, and the segments were made unusually heavy, and the lacing was extended from the bottom of the pole to the top.



LARGEST ELECTRIC RAILWAY POLES.

The arm was formed out of angle iron, and plates with proper struts and rods. The arm was braced in a horizontal plane on the lower chord. An ornamental acorn top was made for the pole, but when the photograph was taken it was not in position. A sliding bracket to adjust the center of the trolley line over the center of the track was also furnished, but it is not very clear in the cut.

The dimensions of the pole are as follows: Length, 35 feet; length of arm, 32 feet 8½ inches; height of arm above the ground, 20 feet 1½ inches; distance of pole set in the ground, 7 feet. The poles are designed to carry 500 lbs. on the end of arm. The total weight of each pole is 2,000 lbs. The poles although subjected to heavy strain, have remained, it is stated, perfectly erect.

The Columbia Arc Lamp.

The cuts illustrate a new type of arc lamp which is being exploited by the Columbia Electric company of St. Paul, Minn.

Among the features of the lamp may be mentioned the compactness, lightness and small measurement from base to top. The height of the lamp is claimed to be about one-third that of the ordinary forms of lamp now in use throughout the country. This last mentioned feature makes it particularly desirable for service in stores, restaurants, etc., where the ceilings are low.

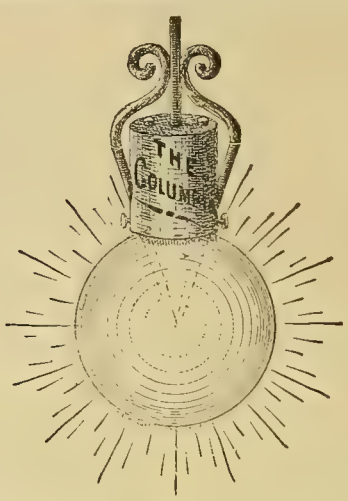


FIG. 1. COLUMBIA ARC LAMP.

The regulating mechanism is quite simple. The carbons are fed by their own weight. A glance at the illustration will make clear the construction of the lamp. The case is made of cast iron, and serves as a support for the globe which is hung below it, Figs. 1 and 2. The brass tube carbon holders make an angle with each other of 60 degrees. These holders are provided on the lower ends with soft iron tips about two inches long. These tips are curved sufficiently to allow the carbon which is held centrally in the brass tubing and has also a free movement up and down, to rest on them about one-sixteenth of an inch.

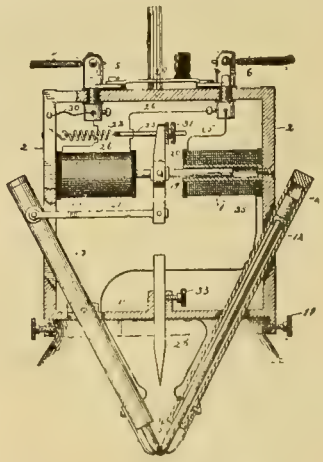


FIG. 2. COLUMBIA ARC LAMP.

The carbons are prevented from falling through when they separate to form the arc by these small iron retaining fingers. The fingers are so adjusted as to catch the carbons, which always burn to a point just half way between the point and where the taper begins. They are simply loosened when new carbons are put into the tubes, and tightened again by the use of a

thumb screw. The carbons as above stated are kept pushed to their places by means of iron weights which slide in the tubes. On account of the angle formed and the upward tendency of heat, the iron retaining fingers do not melt. Fig. 3 illustrates in detail the arrangement of the fingers and carbons.

A magnet is placed directly over the carbon points for the purpose of fixing the position of the arc at the tips of the carbons. This magnet can be adjusted by aid of the thumb screw shown in the cut so as to drive the arc to the very end of the carbons.

Above the brass base plate are placed the main and shunt magnets to regulate the length

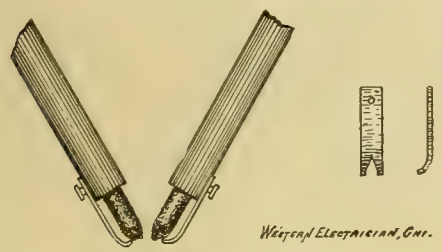


FIG. 3. COLUMBIA ARC LAMP.

of the arc. These solenoids actuate a core which is connected as shown to the swinging carbon holders. The carbons are pressed forward as rapidly as consumed, by the small iron weights on their upper ends. The weights also serve to hold the carbons in a central position. The automatic cut-out is simply a cross connection of wire which short-circuits the shunt coil and arc whenever the carbon has been sufficiently consumed to allow the weight to reach the contact in the lower end of the carbon holder.

It is claimed that the lamp will work satisfactorily on both continuous and alternating cur-

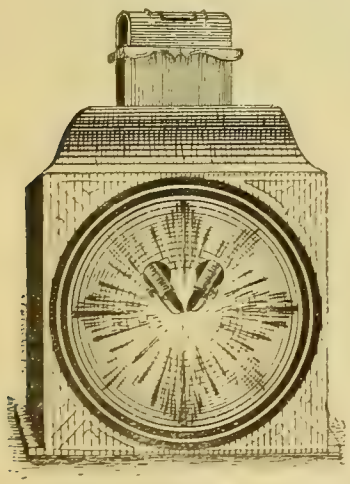


FIG. 4. COLUMBIA ARC LAMP.

rent circuits. The arc always remains at a fixed point, and as the carbons are fed by gravitation the shaking of the lamp aids rather than interferes with the feeding. It will be noticed that there are no side bars and bottom plate to cast shadows. The diffusion of light is therefore by this construction greatly increased. The makers also claim that the Columbia lamp is particularly adapted for locomotive headlight service. One of the accompanying illustrations, Fig. 4, shows the lamp embodied in a locomotive headlight.

Lightning Arrester.

To the Editor of the WESTERN ELECTRICIAN:

I notice in your issue of the 13th a description of a lightning arrester designed by J. J. Wood. It is very ingenious, but the application of an expansible wire to control separating electrodes I designed in the spring of 1889, as shown by my patents Nos. 424,562 and 424,563. In these I also show arc-rupturing devices operated by compound strips adjacent to the arc. While not proclaiming myself the "sole and only inventor," I desire to call attention to the "state of the art" so far as my information allows me to do so. ORLEN P. LOOMIS.

Brooklyn, N. Y., December 20.

The San Diego Electric Transit & Power company is the title of a recently incorporated concern. It has a capital stock of $1,000,000, of which $200,000 has been subscribed. Its purpose is to operate an electric railway system, and furnish electric motor power in San Diego.

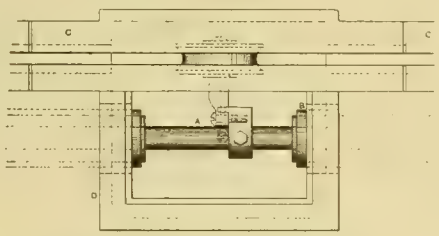
Municipal Control of Electric Plants.

Commenting upon the proposition to establish electric light plants for commercial work under the direction of the city, to which attention has been called by the WESTERN ELECTRICIAN, the Chicago *Daily News* says:

The experiment of establishing the municipal control of electric plants, which has been tried in several cities in this country, has in almost every case proved unsuccessful. This, nevertheless, does not appear to have deterred the city council of Chicago from again attempting to solve the problem, and a committee has just been appointed by that body to take into consideration the acquirement of electric light plants by the municipality. Whatever may be the eventual result of the agitation which is now going on, there is no doubt that there is much to be said in favor of the position taken by Prof. Barrett, the city electrician. He has placed himself upon record as opposed to any scheme that will interfere with franchises now held by local companies. The fact that these companies have gone into business, invested large sums of money in the establishment of their plants and the development of their system, should insure for them recognition of their rights. Prof. Barrett says: "If the city should decide to engage in commercial lighting, it should, in justice to these local companies, buy the franchises and plants now in their possession. Otherwise the city should allow the companies to continue without opposition until the expiration of the terms of their franchises. These men have invested their money in good faith, and common decency demands that their rights be respected. The issue of this question, which will shortly be decided by the acceptance or rejection of a bill bearing on the subject by the Illinois legislature, will be watched with great interest by electricians throughout the country."

Conduit System for Electric Railways.

A conduit designed by E. M. Bentley of New York, for use on electric street railways, is illustrated in the cuts. The conduit is firmly laid in a bed of concrete or asphalt, and is divided into short independent insulated sections. In this manner a bare sectional surface



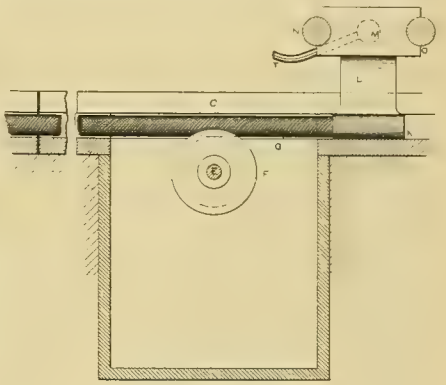
CONDUIT SYSTEM FOR ELECTRIC RAILWAYS.

conductor which as a whole is normally out of circuit with the supply-conductor, is produced. The sections immediately contiguous to the car are successively brought into electrical connection by means of a mechanical circuit-controller attached to the car.

The inventor claims that the sectional character of the conduit will prevent the current from escaping to the return conductor or going beyond the one or two sections which are in contact.

The construction of the conduit will be understood from the following:

In the cuts, *A* represents the insulated feeder incased underground in an iron tube *B*. Parallel to the conductor and in close proximity to it is a small conduit *C*, open at the surface of the street and divided into sections, as shown in the illustrations. This arrangement constitutes a bare surface conductor permanently fixed in position along the path of travel of the contact device, and consisting of independent sections insulated from one another. An enlarged connection box *D* is placed every twenty feet or so along the line, and both the tube *B* and the conduit *C* enter each box. The tube *B* is insulated from the box, as shown, so that the complete insulation of the successive sections of the conduit *C* will be preserved. The feeder has exposed contacts at intervals. Within the connection-box this conductor is laid bare, and there is connected to it an arm *E*. This arm carries a grooved pulley *F*, which comes immediately under the conduit *C*. The conduit *C* within the connection-box is bottomless, and the arm *E*, which is adapted to yield vertically, is held up by a spring, so that a rod or rope *G* in passing through the conduit, would ride upon the upper side of the wheel *F*. This rope *G* forms the contact device. It is somewhat longer than the distance between any two connection-boxes. As it moves along it will be dragged over at least one of the exposed contacts. This rope *G* is connected at each end to a traveler, which is connected in turn to shank *L*, extending from the car above the conduit. The shank *L* is free to move laterally with respect to the vehicle, being connected to a head *M*, which slides upon transverse guides *N* and *O*, attached to a fixed part of the vehicle. A wire *T* connects the head *M* with a motor upon the car. It will thus be seen that as the car advances it will constantly be in electrical connection with the conductor *A* by means of the arms *E* and the pulleys *F*. As the one or



CONDUIT SYSTEM FOR ELECTRIC RAILWAYS.

two sections of the conduit which are at the time also in contact with the conductor *A*, are insulated by the concrete or asphalt bed *P*, there will be, it is claimed, no escape of the current.

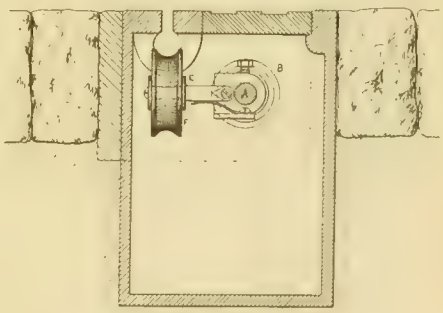
Electric Railway Suit.

During the last week the daily newspapers have stated that the Adams Electric Railway company of St. Louis, was preparing to institute suits against all companies at present engaged in installing electric railways. It is stated that the complainant in its bills will allege that all these companies are infringing fundamental patents owned by it, covering the propulsion of cars by electricity. The Adams company, it is stated, has been reorganized to begin a legal fight, with Congressman-elect Seth W. Cobb, Charles F. Orthwein, Webb M. Samuel and Hugh Rogers & Co., at its head. The patents in question were secured by Dr. Wellington Adams in 1883 and 1884.

Representatives of companies now engaged in installing electric railways are inclined to consider the suits as of little significance. They do not fear that the action will interfere in the slightest with their work.

Underground Wires in Cincinnati.

The municipal authorities of Cincinnati have had under consideration for a year or two



CONDUIT SYSTEM FOR ELECTRIC RAILWAYS.

projects for burying the electric wires in the city. Recently a committee was sent to inspect the underground work in Chicago. In the report to the Board of City Affairs the committee reaches this conclusion:

"The results of the investigation have left your committee impressed with the entire practicability of placing electric wires under ground. Such a system in Chicago is satisfactory both to the city and the companies—the companies in Chicago considering it so desirable that they offered to loan the money to the city for conduit construction when the system was first proposed.

"Your committee recommends that we look toward obtaining necessary legislation to enable the city to construct a common conduit system, for the use of which rental is paid to the city, by companies using same, or if it is thought more desirable, such conduits may be constructed

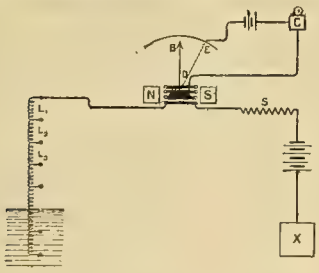
by private enterprise, or by the companies interested. As to how, or by whom a conduit system is constructed, is not so important. The main consideration for the city is, that there shall be a common conduit system constructed, into which all companies shall be compelled to place their wires, so as to avoid the indiscriminate and destructive tearing up of our streets."

High Water Alarm.

Persons living upon streams which at certain times of the year may swell into torrents, threatening destruction to life and property, usually keep a pretty sharp watch on the water. Ordinarily, therefore, they do not require an alarm to inform them of the fact that a stream is rising. Under certain circumstances however, the stream may rise suddenly and the inhabitants living near the banks are fortunate if, by the operation of an automatic device, they are speedily warned of the situation.

The cut represents in outline a plan designed by Marius Otto, a French engineer, for sounding an alarm when the water in a stream reaches a given height. In some public place in a town located near a treacherous stream is placed a galvanometer so connected, as explained subsequently, that its needle *A B*, indicates the level of the water. The scale of the galvanometer is marked in divisions each corresponding to a given level of the stream. The frame of the instrument is tilted so that the needle on one side has greater play.

D E, is a movable arm the end of which can be turned to any division on the scale representing the height of the water at a point considered to be dangerous. When the needle *A B*, moving over the scale, as the height of the water increases, strikes *D E*, the local circuit



HIGH WATER ALARM.

leading to the bell *C*, is closed and the alarm is sounded. In the stream at a distance of, say, twelve miles from the village is located a device L_1, L_2, L_3, which is practically a rheostat; the rise or fall of water removes or inserts resistance in a circuit. Attached to a hollow iron post driven into the bed of the river is a series of insulated metal plates connected by coils L_1, L_2, L_3, each of 10 ohms resistance. The coils are located within the post. The upper plate is connected by wire to the galvanometer which is also connected to the battery of Daniell cells and to earth *X*. If the water rises the resistance coils will be cut out one after the other; as each one is short-circuited the resistance is decreased by 10 ohms, and the needle of the galvanometer advances one division on the scale corresponding to 10 ohms. If the water continues to rise the needle will finally come in contact with *D E*, and the circuit leading to the electric bell being closed the alarm will be sounded. The cut is reproduced from *La Nature*.

Military Telephone System at Antwerp.

The military telephone system at Antwerp, Belgium, is now in operation. All the forts and military establishments, and depots, whatever their distance from the city, the barracks and store houses are connected to a central bureau at the barracks of the company of telegraphers and engineers. Work on the system was commenced in 1881, but since that time many improvements and changes have been made. Since August last the system has been in regular operation. It is essential in this service that communication shall be absolutely secret and that it shall be impossible to hear a conversation by tapping a line and inserting a receiver. It is stated that in the system an attempt of this kind could not meet with success. Small bells of a special design are used to denote the exact instant of beginning and ceasing to talk.

The Improved Gramophone.[1]

By Emile Berlinger.

It might seem strange to you at first that I should commence discussing the gramophone by talking about induction, but I would like to refer to a small portion of a paper which I read before the Franklin Institute in 1888 on the gramophone, when it was first shown, in which occurs the following:

"In my telephonic studies I had become familiar with all the causes influencing the transmission and reproduction of the voice, and what had at all times struck me as forcibly as anything in telephonic phenomena was the fact that the self-induction of long iron wires or of polarized electromagnets acted so detrimentally upon the articulation Electric resistance alone would simply have weakened the sound, but self-induction meant retardation and thus distortion of the transmitted waves which varied in length and amplitude."

And further on:

"In considering such and other facts it became evident to me that if such delicate energy as the voice, subdivided into, maybe, several hundred waves should indent and engrave itself into a solid body, it needed but very slight mechanical resistance to modify considerably the character of the sound vibrations, for what self-induction is to the telephone circuit, the variable resistance which impressible material offers to indentation or engraving at various depths, is the phonographic record sheet. Neither is proportional in direct ratio to the expended energy, and must give cause aside from a reduction in size of the sound characters, also to a distortion of the same."

And that brings me right to the subject of this evening, and I start by further explaining here, that those remarks had reference to the fact that in the phonograph it was impossible to make a loud reproduction which at the same time would be natural in tone. So long as you confine yourself to the small telephone voice the sound is natural and very satisfactory, but so soon as you attempt to indent at a greater depth the waves are distorted and the sound becomes unnatural. In the gramophone, as you will further on see, and I suppose you are perfectly familiar with the principle, there is no indentating and no engraving, but there is a constant resistance, that of the light pressure of an elastic blade on a flat surface, or on a cylinder, if you please, but whatever resistance there may be in it is constant. And that is the principal difference, speaking scientifically, between the phonograph and the gramophone, that in one you have a variable resistance, in the other a constant resistance.

In May, 1888, before a meeting of the Franklin Institute in Philadelphia, I showed publicly for the first time, how sound-records could be etched in metal, and how the original sound could again be made audible from such etchings. What I there demonstrated was of necessity crude in its effects, because embodied in the invention were a number of entirely new processes, new principles of construction and an art which dealt with motions infinitesimally small, the effects of which cannot altogether be either seen or measured; all of which was brought to bear on the single problem of fixing forever and with as much resemblance to nature as possible, both in loudness and quality, the sounds of instruments, of noises of all kinds, and of that delicate and subtile form of energy, called the human voice.

At the same meeting I read a lengthy paper dealing with the history of the twin arts, that of transmitting sound electrically, and that of recording and reproducing the same mechanically. That the development of both arts occurred as I then showed—in parallel steps, is not the only excuse for bringing talking-machines before electrical societies.

In the gramophone, at least, there occur materials and processes, which, partly or wholly electrical, comprise terms familiar to every electrical engineer.[2] Zinc, acid, bichromate of potash, diaphragms, dampers, electrotyping, all these play their part in the technique of the gramophone, not to speak of the possibility of applying electric motors to drive the machines, and of using the current for rapid etching.

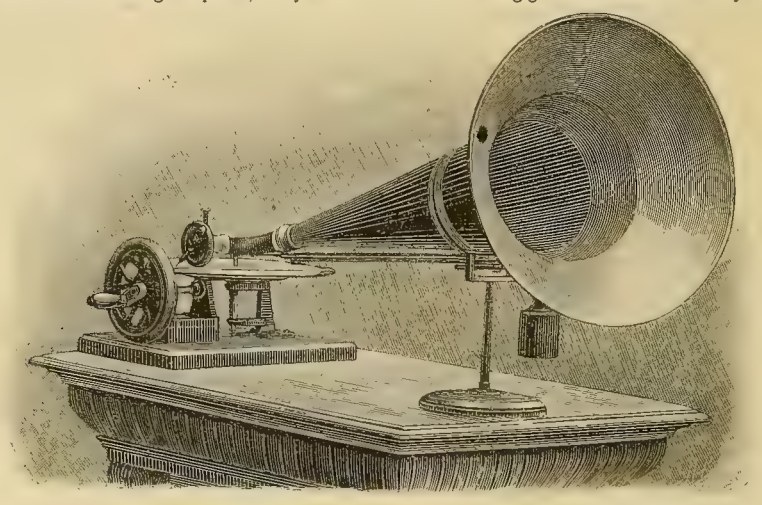
The science of electricity almost began with immersing zinc in acid, but crude force alone is thereby set free, while in the gramophone, the action of the acid on the metal is so curbed and regulated that under it the zinc becomes a picture of sound-waves which, though slumbering in a bed of hard metal, is ready at any time, even centuries hence, to burst forth into the soft cadenzas of word and song, the ripple of laughter, the strains of martial music, as well as the melancholy and imploring drag of the organ-grinder's tuneful melody.

The hydrogen which would otherwise be set free, is neutralized by the well-known depolarizer, chromic acid, and the carrier of the recorded sound-waves is so perfectly and yet so delicately insulated from the action of the acid, that a spiral of sound undulations 600 feet in length, could without difficulty be traced and etched on an 8-inch disc, and would represent when reproduced a continuous conversation lasting seven minutes; all this automatically, and with far greater facility than is possible in making a photograph picture.

In the art of etching, that which insulates the metal from the action of the acid is called an etching-ground, and in the gramophone, this etching-ground is a delicate fatty film, deposited from the fluid state upon the metal surface. This fluid is made as follows: Into a bottle containing one quart of gasoline, benzine or petroleum ether, are put two ounces of scraped, dark yellow beeswax, and allowed to digest, with occasional stirring, for several hours. We shall then find a clear yellow fluid on the top, and a white cheese like precipitate at the bottom. The clear fluid is decanted or syphoned off into another bottle, and diluted with the same quantity of gasoline.

When this fluid is poured on an absolutely clean and slightly warmed metal surface, there remains after the gasoline has evaporated, a delicate fatty film, very porous, and so thin that it shines in iridescent colors. It is somewhat tenacious to the touch, but loses its resistance in a remarkable degree when alcohol is poured over it. As soon, however as the alcohol is washed off with water, the film assumes again its tenacious quality with but very small loss in weight, due to its dissolving slightly in alcohol.

As this etching-ground forms one of the keys to the whole gramophonic art, I will illustrate its qualities by the following experiment:



GRAMOPHONE WITH MEGAPHONE ATTACHMENT.

I have here a strip of zinc, over which the fatty film above described has been deposited from the solution of waxy fat. I have here also a piece of blotting paper, and with its edge touching the film, I now draw several cross-lines on the zinc. Next, I pour alcohol over it and draw a single line over the length of the strip, taking care to touch the surface as lightly as possible. I now wash off the alcohol and plunge the strip in to this glass containing a solution of chromic acid, and you will presently see the long line appear as a dark streak on the zinc, while the cross-lines appear less marked and more reluctantly, showing that the film offered less resistance under the alcohol than without it.

When after about ten minutes, we take the strip out, we will find under a magnifying glass, that the track of each cotton fibre of which the blotting paper consists, is sharply etched into the zinc; the rest of the metal has remained entirely untouched. Such is the nature of the etching-ground used in the gramophone for etching sound records.

I will now illustrate how such records are produced, but I would first like to recapitulate briefly what I dealt with at length before the Franklin Institute, relating to the history of the art of making sound-records of the human voice. That dates back to the year 1857, when Leon Scott patented his phonautograph, which is described in every book on physical science. It consisted, as you see on that picture yonder, of a cylinder mounted on a screw, and turned by hand, a barrel shaped mouthpiece, a diaphragm provided with a damping device, a flexible stylus attached to the center of the diaphragm, and means for adjusting the position of stylus and record sheet to each other. The cylinder is covered with paper smoked with an oily flame, after which the stylus is so adjusted that it presses lightly on the smoked surface. When the cylinder is now revolved, the stylus traces a spiral line on the paper, and when at the same time, sounds enters the barrel, the diaphragm will vibrate, and the spiral line assume an undulatory form, according to the nature and pitch of the sound emitted.

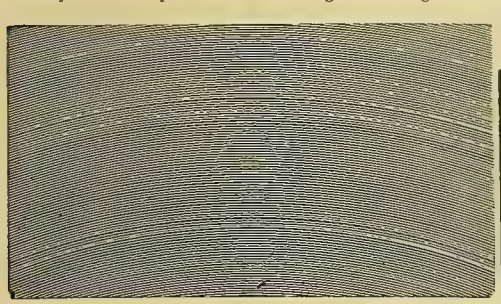
Such tracings of sound are called "phonautograms," but since I have found that those published as having been

1. Read before the American Institute of Electrical Engineers, December 16, 1890.

2. For the illustrations, The Western Electrician is indebted to the publishers of the *Scientific American*.

made by the phonautograph are not true curves of the sounds they were supposed to represent, I have here some which are more correct, and drawn from gramophone records, representing some of the more prominent vowels. The waves are complex in character, and between 75 to 150 of these compound waves follow each other per second in the pitch of the ordinary human voice; all of which is well known, and described in the chapters on sound of physical science

In the spring of 1877, and following in the wake of the invention of the speaking telephone, it occurred to Charles Cros of Paris, that if such sound tracings could be engraved, for instance, by the photo-engraving method, and the stylus be then permitted to travel again in the groove

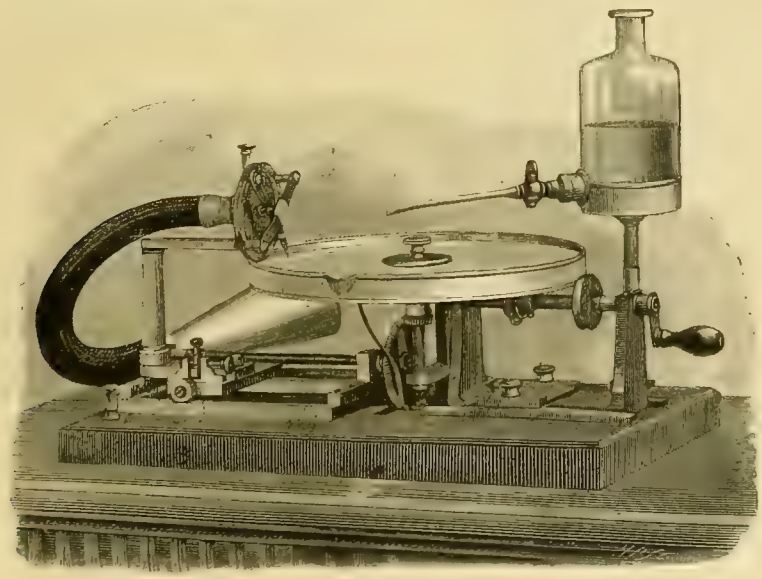


GRAMOPHONE SOUND RECORD.

SOUND RECORD MAGNIFIED.

or track of these engraved record lines, by revolving the cylinder past the stylus, the original sound would be reproduced. This was about 6 months before the invention of the phonograph, but the technical difficulties which appear in the attempt to bring about the desired result, must have seemed too great to Cros: or he must have gotten discouraged when, later on, seeing the apparently simpler method of the phonograph. At any rate, it appears that he never accomplished what he had conceived with such acute logic, and his paper on the subject (which can be found in the *Comptes Rendus*) was barely noticed, and quickly forgotten

It was not until after the granting of the patent for the gramophone, that I happened to see a reference to it, and searching the *Comptes Rendus*, found the article mentioned, which I then translated and embodied verbatim in my paper before the Franklin Institute. While, however, Cros had a correct conception of the general principle of a talking machine, it would have required considerable modification of the rules taught by physical science which were



GRAMOPHONE.

then at his command to obtain practical results: but I will illustrate what he meant, with this model built on the principle of the gramophone.

Here is a drum head of oil-cloth, and across it and pivoted at the top, is an arm or stylus, which is connected to the centre of the drum, and therefore, moves with the latter. The free end of the arm extends beyond the periphery of the drum and carries a brush dipped in ink.

If I now pass a strip of paper underneath the brush and at the same time move the drum regularly to and fro, an undulatory line of regular character will be drawn on the paper. If I repeat the experiment, but more irregularly, or jerky, the motions of the drum appear marked down as a jerky, irregular line.

I now replace the brush by a hard stick and permit it to travel in an undulatory groove engraved in a strip of wood, which strip I draw underneath the stick, and you will see by the reflection of light on the oil-cloth drum-head, that it is moved to and fro by the engraved wave-line, and if these motions should occur rapidly enough, a sound would be emitted by the drum.

This illustrates the general principle of the gramophone. It is, however, in the method of engraving the sound-records that the gramophone departs materially from previous methods, and this I will now show you. Here is a disc of ordinary zinc, such as you can buy in every tin-shop; it has been polished, carefully cleaned and has then been coated with our fatty film. I now place the zinc on the turn-table of the gramophone recorder. The turn table is revolved by a friction-wheel underneath, and connects through gearing with a screw, which propels a carriage across the turn-table, at a slow rate of progression. On this carriage is mounted the recorder proper, namely, a mica diaphragm, across which lies a spring, fastened above and carrying at the lower free end a slender metallic blade, bent downward slightly, and tipped with iridium, like a gold pen. This blade I now bring down upon the fatty film until it is straightened

Mounted near the turn table is a bottle containing alcohol, from which a spout extends to the center of the turn-table, dropping the fluid upon the fatty film on which I first pour some of it, so as to soak it.

If I now revolve the turn-table, the blade or pen marks a plain line into the fatty film, and as the iridium tip is kept free from the dust-fibres which are continually floating about in the air, and upon the film also, by the presence of the alcohol the line in proper light appears as a fine silvery streak in the dull, fatty surface, showing that the metal is being laid bare by the iridium tip.

If, now, sound enters the tube leading to the diaphragm, the latter will vibrate and the line will assume the undulatory form of sound-waves, as before explained

The gearing of the machine is at present set so that 72 lines are drawn to the inch; but for the ordinary conversational tone, the lines might be twice as close together, without the waves touching. The turn-table revolves at the rate of about 60 times a minute for this size of disc, and if they are smaller the velocity must be increased, so as not to crowd the waves too close upon one another.

The talking being done, I lift the disc from the machine and dip it in water, which washes off the alcohol, and there is now visible a band of silvery lines in the fatty film. I may now write the date in the central portion of the disc, and press the patent-stamp on it, or add any other remark or signature, all of which will be subsequently etched in, and I may now plunge the disc into the bath of chromic acid. Immediately, the acid attacks the zinc in the lines, and a dark cloud forms over the record, due to the formation of a subchromate of zinc

While the disc is being etched, let me now turn to the reproducing machine. The principal part is again a turn-table moved by a friction wheel underneath. Above it is an arm pivoted with one end upon a standard having a double or universal motion, and the other end carries the reproducer proper, namely, a diaphragm or mica vulcanite fibre, rubber, or ivory, across which is fixed at its upper end, a stiff spring connected by a post to the center of the diaphragm, its free end extending beyond the periphery, and carrying a small steel needle which may easily be taken out and replaced when necessary. This pivoted arm is the invention of Werner Sues, of Washington.

One of the mechanical curiosities of the gramophone is the fact that the etched record itself is the screw which propels the diaphragm from periphery to center, for the stylus resting in the groove by gravity or slight pressure, not only is vibrated, but following it and being able to move freely, is led along to the center and to the end of the etched record automatically. This places the gramophone reproducer in the realm of extreme simplicity, and beyond the necessity of repair under ordinary everyday conditions.

Before proceeding further, I will now let the gramophone show you some of the results of what it is capable of doing at the present time. I should like to remark, that in the present form of the resonator, the sharpness of the effects is somewhat toned down. That this is due to the resonator will become more apparent to you when, later in the evening, you will listen to some of the discs through the rubber ear-tubes. It has been proposed to use a resonator in the form of a large parabolic reflector, so as to enlarge the effects without modifying the timbre. But the effects, although loud, show the natural qualities of the various sounds, and are, in spite of their loudness, neither rasping nor ventriloquistic in quality.

The possibilities of extending the gramophonic principle, are perhaps more noteworthy than its present development. The discs can be easily duplicated, and at the first exhibition in Philadelphia, I showed an electrotype copy of a 12-inch disc which sounded precisely like the original. Since then, I have also succeeded in making talking copies by pressing a matrix into molten glass, but the matrix being of copper, the glass used to stick to the form, and warped the glass copy. I am assured, however, that whenever I shall furnish a steel matrix, the perfect copying in glass will be entirely feasible. That such steel matrices can be made is not doubted by those familiar with the art of transferring lines, and then etching the same.

We may then have dinner sets, the dessert plates of which have gramophone records pressed in them and which will furnish the after-dinner entertainment when the repast is over. Gramophone plaques with the voices of eminent people will adorn our parlors and libraries.

Very successful copies have been made in celluloid from electrotype matrices and such celluloid copies are particularly free from all frictional noise, provided the celluloid is pressed hard, and of well seasoned material. Gramophone records have been printed, and such prints have been photo-engraved, and the copy thus obtained sounded precisely like the original.

Successful copies have been made by letting one disc sing or talk to another one by coupling the recorder to the reproducer by a tube, and turning both simultaneously. In fact, this whole matter of duplicating discs is a department in itself, and would require a separate evening to do it full justice.

The work of gradually bringing the gramophone up to the present state has been exceedingly tedious. Working out telephones or transmitters is child's-play in the face of the traps and Jack-o'-lanterns which beset the experiments with talking machines. The size, form and material of the mouth piece, the density, length and diameter of the speaking-tube, the size, thickness and material of the diaphragms, the tension, temper and thickness of the springs, shape of the needle points, temperature of the room in which the discs are coated, the quality of the bees wax, the strength of the acid, and the method of manipulating the sound of voices and of various instruments—all these gave rise to errors and pitfalls, which only continuous repetitions of whole series of tests could locate, avoid, or obliterate.

I have to dwell on these facts, in order to ask your indulgence in not having been able for this evening to cover the important field of copying records—but I have also been disappointed in not receiving a number of celluloid discs such as are now being made in Germany.

The important subject of good articulation has ever been kept in the foreground, and this is now in so satisfactory a shape that I am carrying on a vocal correspondence with my friends in Europe, by means of small gramophone discs, which can be mailed in a good-sized letter envelope.

Foremost among the feats which the gramophone can perform is the absolute certainty with which it enables people to recognize the speaker's voice, and I could cite a number of instances where persons have been made happy by hearing and recognizing the voices of loved ones whom they had not seen in years, and the owners of which were thousands of miles away.

This whole art is now manipulated with great certainty, and can be learned much easier than the art of photography. Yet, favorably as I believe the gramophone compares with other talking machines, it has barely entered upon the possibilities which lie dormant within its principles, only awaiting the touch of investigation to yield new and important scientific data

Its advantages at the present time can be summed up as follows:

1. The records are durable, and require a minimum of space for storing.
2. Recognition is perfect.
3. The mechanism of the reproducing machine is a model of simplicity.
4. The records can be printed, and from such prints copies can be made which will sound like the original.
5. The quality of the sounds does not become impaired with increasing loudness.
6. The making of copies is possible by several well-known methods in existing arts.

Lastly, I ought to again refer to the possibilities of enlarging the record lines by the photo-engraving process, and thereby rendering the sounds with increased loudness.

Whatever the art of gramophony represents at the present time, does not consist of accidental results, but the principles and the errors to be avoided are well-known and established, and not a month passes but that new light is thrown on hitherto obscure sections of manipulation, and after three years of work, in which numberless sources of error have been eliminated, the art of etching records has lost none of its attraction, rather fascinating the mind by presenting the possibility of unlimited applications in the service and for the pleasure of mankind.

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W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - } Associate Editors.
J. B. O'HARA, - - - - - - - - - - }
F. L. PERRY, - - - - - - - - - - }
A. C. DURBOROW, JR., - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.

W. H. TEMPLE, Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE street car systems in many cities have suffered considerably from severe snowstorms during the last week. The St. Louis papers, in commenting upon the interference to traffic, state that the electric cars experienced the least difficulty in making schedule trips, while the cable system was badly crippled.

EMIL BERLINGER in his paper on "The Improved Gramophone," which appears in this issue, explains the principal difference between the phonograph and gramophone. In attempting to make a loud and natural reproduction by phonograph by mean of deep indentations, the words become distorted. In the gramophone there is no indenting; the resistance of the surface to the point is a constant one.

THE records of the Patent Office go to show that the arc lamp now in service is considered by some inventors a rather clumsy device. When it is desired to illuminate rooms with low ceilings, then it is that one objectional feature at least, becomes evident. The height of the arc lamp is without doubt in many cases an objectionable feature. While there have been a number of lamps which were designed with the view of overcoming this objection, there is still room for improvement. In another column a lamp is described which, it is claimed, possesses the advantage of a small overall measurement as well as several other good features. The carbons burn at an angle, and the feeding is accomplished by gravity. The controlling mechanism is simple and ingenious. The most interesting feature is the manner in which the arc is made to play across at the extreme ends of the pencils. The inventor utilized the "magnetic blow-pipe" as a means to attain the end.

THE reading public has so often been regaled with articles in the daily papers and more pretentious journals in which fears are expressed that the lives of firemen and spectators at conflagrations were endangered by the presence of electrical wires, that there has been a general demand for devices which would enable linemen to cut out any portion of the circuit. Improvements and devices are numerous to-day, yet those whose interests are opposed to the development of electric lighting vigorously protest against overhead wires, etc. In view of the injustice of this position, it may not be amiss to direct attention to the fact that those who have cried out the loudest against electricity might have employed their time to better advantage in perfecting their own systems of lighting and reducing the danger to health, life and property. Only recently, during a fire at Chicago, there was an incident that should impress this upon their minds and it was not an unusual occurrence either. A gas explosion in the basement of the Burton block, shook the foundations, toppled over walls and blew up the sidewalks about the building. These accidents, however, have become so commonplace that they are accepted in the regular course of events without comment.

THE board of trustees of the new University of Chicago, for which the Baptists of the country have raised an endowment of over a million dollars, met last week and adopted a plan of organization. It is interesting to note that the trustees have in view a comprehensive educational system. In the university system will be incorporated as many colleges for instruction in special departments, as time shows are needed, and as funds are available. Inasmuch as a number of wealthy men, including John D. Rockefeller, who has already contributed $600,000, are interested in the institution it will not, in all probability, suffer from any lack of funds. It is an interesting fact that one of the first extensions contemplated by the trustees is the organization of a college of electrical engineering. Every one connected with electrical interests in Chicago will be exceedingly glad to know that the formation of such a school is even possible. The number of inquiries from young men who want to study electrical engineering, and who desire at the same time to remain in Chicago, is already great, and is constantly growing. There is unquestionably a need for such an institution and we trust that the school will be one of the first to be organized by the trustees.

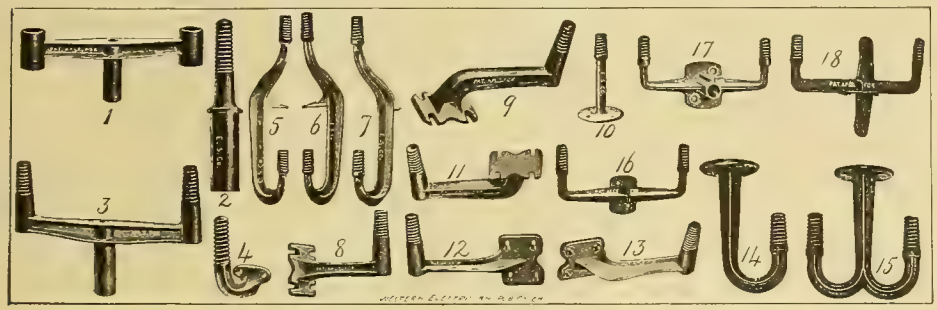
IT will be seen in an article relating to the Chicago city electric light plant which appears elsewhere in this issue, that another step has been taken in the scheme to develop a system of commercial lighting to be controlled by the municipality. A committee of influential citizens appointed to consider a number of suggestions of Mayor Cregier, has approved the recommendation providing for such an extension of the city lighting system. The legislature will be called upon to pass an enabling act authorizing the city to organize such a system. Undoubtedly the approval of the citizens' committee will have great weight, and the electric lighting interests of Chicago may have a hard fight to wage against the measure. If the companies are called upon to combat the project, they should receive the earnest support of illuminating companies throughout the country. The municipal ownership of lighting plants commends itself to many councils. Within the last few weeks a committee from Philadelphia came to Chicago to examine the city plant, inasmuch as a municipal system to compete with existing companies is under consideration in that city. The fact that the head of the electrical department, Prof. J. P. Barrett, is opposed to such a scheme, affords the best ground for believing that the Illinois legislature will not pass measures calculated to interfere with established electric light companies.

THE electric cars of Buffalo were operated for the first time a few days ago and, naturally enough, they have been rather crowded at times. This fact has caused one of the local papers to discuss the advisability of limiting the number of passengers on the electric cars to such as could be accommodated with seats. Just at the present time the papers throughout the country are commenting on the subject in view of the fact that the House of Representatives has passed a bill establishing for the street car lines of the District of Columbia the principle of "no seat, no fare." Leaving the preferences of the companies out of the question, and regarding street cars merely as public conveniences, we think that a very great proportion of their patrons would prefer to have the rule remain as it is, and content themselves with standing room at times. At certain hours of the day street car companies in large cities cannot provide cars enough, no matter how many are put on their lines. The ordinary American would sooner put up with almost any inconvenience than wait aimlessly for a car with vacant seats. The European practice is to make the seating capacity, and the carrying capacity identical, and it works well enough in foreign cities where the passengers do not live in a hurry. But the American visitor at times is exasperated almost beyond endurance by seeing half a dozen or more cars pass him which he is not allowed to enter because they are carrying their complement of passengers. The American custom of crowding a street car at such times seems a very sensible one. Until the character of the average American is so modified that he will cease to live in a continual rush there is little chance that the rule of "no seat, no fare" will have a general application in American cities.

IN this issue is presented Prof. F. B. Crocker's paper on "Electrical Units of the Present and Future," which was recently read before the New York Electric club. Prof. Crocker treats his subject in a most comprehensive manner. He first indicates how a necessity for exact units was created by the development of exact sciences. He refers to the difficulties encountered in the establishment of absolute standards, and illustrates the unsuitability of many units now in use. After alluding to several standards and touching briefly upon their history, Prof. Crocker leads the reader along most satisfactorily to the consideration of electrical units. Existing absolute and practical electrical units are discussed, after which the author takes up the subject of self-induction and its proposed unit, the "Henry." Prof. Crocker deemed it best to consider self-induction as a counter electromotive force. The best definition of the unit of self-induction is, he thinks, that which describes it as giving a unit counter electromotive force when a unit change of current occurred in a unit time. The ordinary way of deriving this unit, is to multiply resistance by time. At this point in his paper Prof. Crocker calls attention to the impracticability of certain of the so-called practical units. He maintained that we must have a third system, that is, a system of "working units." When we come to the "henry," Prof. Crocker thought it would be a question whether the working unit would be a "henry" or a "milli-henry." He deemed it fortunate that the henry approximates a practical value. The fact that the henry had been called a quadrant by the Paris conference, he considered, a great unfairness to American electrical men. One unit at least should be named after the discoverer of self-induction, Joseph Henry. With reference to future units, Prof. Crocker stated that the requirements of advanced work would soon necessitate the unit of the strength of a magnetic field.

High Insulation Brackets.

The system of high insulation brackets shown in the cuts has recently been completed by the Electrical Supply company of Chicago. By careful designing the new forms have been made neater in appearance, and at the same time stronger than the old ones. The castings are split at the screw, so that the danger that an insulator may be broken by the expansion of the metal is prevented. It is often necessary to attach the brackets in places where one man must work at a disadvantage. It will be noted in the cuts there are slots instead of screw holes. The screws or bolts for one side are driven in first; the bracket is then hooked on and supported in position while the remaining fasteners are inserted. This construction not only simplifies the application of the brackets, but makes their removal an easy matter. There is a great variety of forms; brackets to go above, below or around all sorts of wiring obstacles and yet hold the insulators always in their only effective position—that is exactly perpendicular.



HIGH INSULATION BRACKETS.

1. Removable Pin Break Arm Bracket. 2. Iron Pin Bracket. 3. Permanent Pin Break Arm Bracket. 4. Side Bracket. 5, 6, 7. Spreader Brackets. 8. Wall Bracket 9 and 10. Roof Brackets. 11. Cornice Bracket. 12, 13. Lateral Brackets. 14 and 15. Ceiling Brackets. 16 Converter Bracket. 17. Reflector Bracket. 18. Combination Bracket.

Lemp Welding Apparatus.

It is well known that joints made by the electric process are generally butt-welded. Longitudinal pressure is applied to the metals to force the abutting ends together at the time the current has made the metal soft. In most cases this pressure is applied while the current is still flowing, and consequently it is necessary to have some means of carrying the current to the metal at the time it is moving. The practice has been to provide two parts with smooth polished surfaces, one sliding on the other, the metal to be worked being clamped upon the sliding part, and a connection being made between the other and the source of current. This necessitated very fine mechanical construction of the surfaces, in order to lessen the resistance at that point and avoid loss of power during the flow of heavy currents. In working with heavy pieces of metal too fine construction is not compatible with the rough usage that such a machine receives, and in time the parts become worn and bent out of shape, so that new fittings are required.

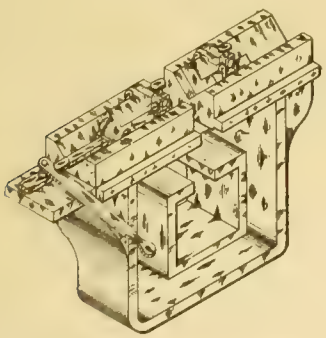


FIG. 1 LEMP WELDING APPARATUS.

By the arrangement illustrated in the cuts, which is the invention of Hermann Lemp of Lynn, Mass., the number of contacts are not lessened; but through its use two important objections are avoided, namely, the nice and careful construction of sliding contacts and the necessity of making heavy current-carrying devices in order to stand the wear and tear.

Fig. 2 shows in perspective a welder embodying Mr. Lemp's modification. Fig. 1 illustrates a type of machine formerly employed. In this latter machine there is a V-block, in which the bar is securely held by a gripping device. A rod connects the lever with the V-block, and this provides the means for longitudinal pressure. This cut clearly illustrates how the current is collected from the secondary and given to the stock, and also shows how easy it is for the V in the secondary to become dirty or coated with grit, so as to impair the contact and cause heating when large currents flow.

Referring now to Fig. 2, the construction of the improved apparatus will be understood: *S* is the secondary, *P* the primary, and *C* the iron core of the transformer in the welder. *T* is an upright projection on a terminal of the secondary. This portion is an integral part of the casting which forms the secondary. *H* is a copper casting of the same form and dimensions as *T*, but is capable of being slid on the casting and fastened in any position by means of screws. The object of making this casting movable is to get variations of projection of the stock beyond *T* and *H*, according to the diameter of the bar to be welded. This construction is essential to good results in welding by electricity. *D* is a steel plate with side guides fastened to but insulated from *S*. *M* is an ordinary centering-chuck, which slides on the plate, and in the guides, and grasps the work. *N* is another centering-chuck, which is insulated from *H*, but is secured to that casting, so as to move with it when required. It will be noticed that the difference between the right and left sides is this, that *M* may change its position with regard to *T*, which is stationary, and that *N* does not change its position with regard to *H*, but is moved with it. The construction of the part *T* and *H*, is illustrated in Fig. 3. From the inside surface of the round hole in these parts and extending radially outward, are made three holes equidistant. When the handle is moved to the position shown by the full lines, springs force the pieces in the holes toward the center to the position shown by the full lines.

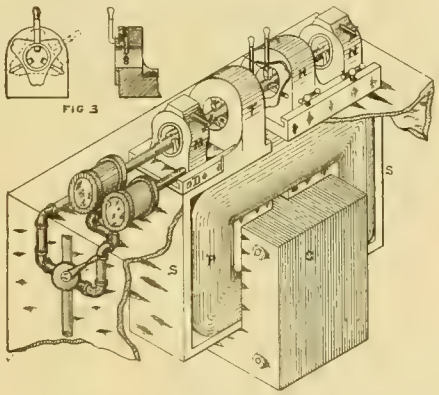


FIG. 2 AND 3. LEMP WELDING APPARATUS.

The operation of the machine is as follows: If two bars are to be welded they are pushed through until their ends abut against each other. The jaws of *T* and *H* are then closed tightly upon the bars. The handles are now moved so as to bring the rods down on the bars, and make contact with them. As the mechanical chuck is insulated from the secondary of the transformer, it is evident that the entire contact for the flow of current is made by these three pieces, which bear down rather hard by reason of the pressure behind them. As the current heats and softens the abutting ends, the rods are forced together. The noticeable difference between this action and the one illustrated in Fig. 1, is that the distance between the contacts representing opposite polarity, remains the same in the former, while in the latter it decreases as the longitudinal pressure forces the bars together. The principal advantage to be observed, however, is that there are no sliding surfaces which must be kept in perfect order free from dirt or grease, etc. The contact-pieces used are so simple and cheap that they may be easily replaced when worn out. It is claimed also, that by using a number of contacts arranged in a circle or around the stock a better distribution of the current, especially on large work, is obtained.

Judge Blodgett's Decision in the Brush-Fort Wayne Litigation.

In the last number of the WESTERN ELECTRICIAN it was stated that Judge Blodgett in the United States Court had handed down a decision in the case of the Brush Electric company against the Fort Wayne Electric company restraining the defendant from making or selling the Wood arc lamp on the ground that it was an infringement of Charles F. Brush's patent. Judge Gresham who heard the case concurred in the decision. Following is the full text of the decision:

This is a bill for an injunction and accounting by reason of the alleged infringement of patent No. 219,208, granted to Charles F. Brush, on the 2d day of September, 1879, for "an electric lamp."

The suit was commenced on the first day of July last, and complainant very soon thereafter moved for an injunction, *pendente lite*, which motion was heard in the early part of October last.

This patent has been four times before the courts of this circuit, and once before the Circuit Court for the Northern District of Ohio, presided over by Judges Brown of the Eastern District of Michigan, and Ricks of the Northern District of Ohio, in which cases the patent was carefully considered in the light of the prior art, and its novelty and utility fully sustained.

The only question seriously contested upon the hearing for the injunction was that of the alleged infringement of the defendants' device upon the device covered by the complainants' patent.

The defendants manufacture electric lamps made substantially in accordance with the patent granted to James J. Wood, on the 24th of June.

The Wood lamp, like that of the Brush, is a duplex lamp, organized to burn two or more pairs of carbons successively, but the feeding device of the Wood lamp is partially actuated by clockwork instead of its being done entirely by action of the electric current, as in Brush.

In the Wood lamp, however, the clockwork mechanism is brought into action and controlled by the electric current.

The distinguishing feature of the Brush lamp is the arrangement of the feeding mechanism so that the carbons of the two pairs shall be dissimultaneously separated for the purpose of forming the arc, and after the arc is formed, one of the carbons of the pair between which the arc is formed, shall be fed toward the other as fast as it is consumed so as to preserve a steady and uniform light, and that when the first pair of carbons is fully consumed, the current is automatically transferred to the other pair, and the arc formed between them, which are, in turn, fed up and consumed by the feeding device.

The Wood lamp has the same characteristics; the carbons of each pair are dissimultaneously separated, and the arc is formed by the action of the current passing through the magnetic coils, as is done in the Brush lamp; but the feeding, as the burning carbons are consumed, is regulated in the Wood lamp by clockwork.

It does not seem to us that the interposition of this clockwork to do the feeding after the arc is formed essentially differentiates the Wood device from that of Brush. The electric current is the efficient motor in both lamps for forming the arc. Brush evidently saw that the feeding could be done in many ways after the arc is established.

He showed a clutch mechanism for doing the feeding, but expressly says in his specification:

'I do not in any degree limit myself to any specific method of mechanism for lifting, moving or separating the carbon points or their holders, so long as the peculiar functions and results hereinafter to be specified shall be accomplished." And further on in his specifications, he suggests that clockwork may be substituted for his clutch mechanism.

Before Brush entered the field, electric lamps had been contrived which burned two sets of carbons alternately, shifting the arc from one pair to the other at short intervals, making a flashing, unsteady and unsatisfactory light.

The problem which Brush set himself to solve, was to secure the complete combustion of one pair of carbons before the arc was transferred to the other pair, and the transfer of the arc to the other pair by the automatic action of the electric current, so that no attendant was needed to light the second pair after the first was consumed, and thus secured a lamp which would give a steady arc light of from 16 to 20 hours' duration.

This he accomplished by his mechanism, which caused the dissimultaneous separation of the two pairs of carbons by the automatic action of the electric current actuating his separating devices, and a feeding device for bringing the carbons together as fast as they were consumed.

This long step forward in the art was taken by Brush, and at the present stage of the art, it seems that the inexorable law of the electric current, requires that when two

or more pairs of carbons are to be burned successively, the carbons of each pair must be dissimultaneously separated, and the arc produced between the last pair separated. Having done this for the art, Brush is entitled to cover all means equivalent to his own for obtaining the same result, one of which is, a clock work feeding device.

The argument ingeniously and ably made in behalf of the defendants, is that Wood has evolved his lamp along the lines indicated by the inventions of Denayrouse and Meynall, who had preceded Brush.

But neither of these inventors produced a lamp where the carbons would be burned successively. It seems to be the history of many great inventions that the minds of many persons, without any concert of action, are at about the same time attracted to the subject, and each sets himself at work to invent a mechanism which shall produce the desired new result—meet the felt public want. One of the experimenters succeeds, while all the rest fail. After the one has succeeded, it is easy to go back into the limbo of these old failures, and, in the light of the successful machine, by, perhaps, slight changes, make these old abortive attempts do the work of the successful inventor

But it is the successful inventor who has shown the way, and he, and he alone, who is entitled to be called the inventor, can be protected by a patent. The successful inventor may even have taken advantage of hints and suggestions from the abortive attempts of others; but that does not entitle them, or any one else, to appropriate his successful machine.

It was strenuously argued by the able counsel for the defendants, both in his oral and printed arguments, that the Brush patent shows two feeding devices, while the Wood lamp shows but one feeding device or mechanism.

This position, if correct, would hardly, we think, answer the charge of infringement; but we do not entirely agree with the learned counsel in his position that Wood has only one feeding device. The clockwork mechanism of Wood is practically as much a separate device for each pair of carbons as the clutch mechanism of the Brush, for, while Wood's clockwork is made to feed each pair of carbons in turn, it feeds the first by one pinion, and the next one by another pinion after the arc has been produced between the second pair by the action of the electric current, thereby making his device as much a duplex feeding device as that of Brush.

The feature of the Wood lamp which allows the attendant, when he lights the lamp or puts the lamp in circuit, to separate the carbons of one pair by hand instead of allowing that to be done by the operation of the electric current as is done by Brush, does not, it it seems to us, in any degree, evade the Brush patent, because it clearly appears from the proof, and operation of the machines as exhibited upon the hearing of the motion, that if the attendant did not latch up the upper carbon of one pair, the mechanism itself would automatically do so, the same as it is done in the Brush lamp; and the manual separation of one set of carbons, even before the lamp is lighted, is nothing but the adoption of Brush's dissimultaneous law; and it leaves the arc to be formed between the pair of carbons last separated.

In this, as in almost all cases of infringement, there are slight differences in mode of construction and devices for the result accomplished by the patent.

It is rare that we find a patent that is copied with Chinese fidelity from that which it is claimed to infringe; but the infringers always endeavor to escape the charge of infringement by some modification which shall apparently cause their machine to differ from that of the patentee. The essential thing, however, to be considered in all such cases is whether the principle embodied in the patent has been substantially used by the defendant, and, if we find hat it has been so substantially used, it is the duty of the court to protect the patentee, however ingenious may be the mode of infringement.

The motion for an injunction is therefore sustained.

President Harrison's World's Fair Proclamation.

Most of the American readers of the WESTERN ELECTRICIAN have read the proclamation of President Harrison inviting foreign nations to participate in the World's Fair to be held in Chicago in 1893. Foreign readers, especially those interested in the electrical department, will be glad to peruse the proclamation, which follows:

A PROCLAMATION.

WHEREAS, Satisfactory proof has been presented to me that provision has been made for adequate grounds and buildings for the use of the World's Columbian Exposition, and that a sum not less than $10,000,000, to be used and expended for the purposes of said Exposition has been provided in accordance with the conditions and requirements of Sec. 10 of an act entitled "An act to provide for celebrating the 400th anniversary of the discovery of America by Christopher Columbus, by holding an International Exhibition of arts, industries, manufactures, and the products of the soil, mine and sea, in the City of Chicago, in the State of Illinois," approved April 25, 1890,

Now, therefore, I, Benjamin Harrison, President of the United States, by virtue of the authority vested in me by said act, do hereby declare and proclaim that such International Exhibition will be opened on the first day of May, in the year eighteen hundred and ninety-three, in the City of Chicago, in the State of Illinois, and will not be closed before the last Thursday in October of the same year, and in the name of the Government and of the people of the United States, I do hereby invite all the nations of the earth to take part in an event that is pre-eminent in human history and of lasting interest to mankind, by appointing representatives thereto, and sending such exhibits to the World's Columbian Exposition as will most fitly and fully illustrate their resources, their industries, and their progress in civilization.

In testimony whereof I have hereunto set my hand and caused the seal of the United States to be affixed.

Done in the City of Washington this twenty-fourth day of December, one thousand eight hundred and ninety, and in the independence the one hundred and fifteenth.

[Seal.] BENJAMIN HARRISON.

By the President:

JAMES G. BLAINE, Secretary of State.

Electrical Units of the Present and Future.[1]

BY PROF. FRANCIS B. CROCKER.

The subject of my lecture is unfortunately, but necessarily, a dry and somewhat difficult one. My only excuse for presenting it to you is the fact that it is certainly a matter of fundamental importance, and also that it is one about which most electrical men are, to say the least, not perfectly and clearly informed. It is a matter which usually one has no opportunity to learn. When most of the men in the electrical profession obtained their education, they picked it up, so to speak, as there were no regular courses of electrical instruction. In picking up information it is usually very hard to get, and one is apt to postpone it. No time comes for sitting down and finding out how the electrical units were derived, what they mean, and how they are related to each other, etc., etc.

The complicated and unattractive condition of the subject of electric units is partly due to the fact that it is a growth, and partly due to the fact that it is naturally and inherently a heavy subject. If to-day a system of units were to be devised, it would probably not be the present one. But the best system that could be devised would be difficult and complicated

The matter of electrical units and electrical measurements is precisely similar to all other measurements. What is true of electrical measurements is true of others; in fact, electrical measurements are derived directly from ordinary measurements. If we go back historically to the origin of the subject, we find that in ancient times men did not require exact measurements. Numerous facts were presented to the view then as now, but men were satisfied with rough ideas. For example, even at the present time we know a physical fact just as well whether we measure it or not. I know the existence of the Hudson River or the Capitol at Washington, just as well whether I measure it or not. I think that is a point that is not generally realized—the fact that we may perfectly and clearly know a thing without measuring it, although physicists are apt to think that unless we measure it we know nothing about it. But as soon as we come to definite work, either in science or commerce, measurement is everything, and the mere existence of the thing is of little consequence compared with its value. For example, in the case of a steam engine, the whole question is whether it is one or twenty or a thousand horse-power. Its mere existence is not important, and no one would buy a steam engine, or think of considering a steam engine, except in the most careless way, without knowing its power. It depends on circumstances whether we need measure a thing or not.

To measure quantities of any kind some unit is needed. In the crude ancient days that I referred to, the roughest kinds of units were sufficient. The length of the king's foot, of a barleycorn, or the side of some temple, or a stone in a pyramid, or something of that sort, were quite good enough for a unit. In fact, nothing better was needed. But as soon as the exact sciences developed astronomy, mechanics and other branches of science, and when commerce became more important and definite, the necessity for some more exact unit arose. The rough units that I refer to are not only rough, but they are arbitrary. They might just as well select some other king's foot or some other stone in the pyramid, instead of the particular one selected. The more exact requirements of advanced work at first only required definite standards. Therefore the standard yard and the standard quart were adopted, but they were arbitrary. Some person decided what that should be and they were carefully made and deposited in the national archives, and exact copies of those were made and sent around to various points, and they became in some cases the legal standards.

Standards can be adopted by custom or by law. Some of the standards in common use are legalized and some are not. One or more of our most common standards have not been legalized.

So far they had merely arbitrary units. The quart bore no relation to the yard; the yard bore no relation to the second, and neither of the three bore any simple relation to any other unit. That is to say, the fraction representing the relations between the two would have several decimal places. But nevertheless each was definite in itself. The standard yard was a definite length of metal and carefully preserved. Therefore, it was as exact as any unit can possibly be, but it had the disadvantage of having no simple relation to any other unit, and when we pass from yards to quarts and from quarts to pounds, etc., we have no convenient way of translating the quantities. We are obliged to use very awkward figures. What is needed is an *absolute system* in which the units bear exact and easily remembered relations to each other. That is the essence of what is called the absolute system. But it happens that an absolute unit is a very hard thing to obtain. It is impossible to look about and find a standard length that is derived from any source that is unquestionable. It is a matter of judgment and choice, and nothing seems to be very satisfactory for the purpose.

The waves of light would seem to be one of the most definite and one of the most ideal sources of a system of units. Each particular point of the spectrum has a definite wave length, and it also has a definite wave rate That would give us a unit of length and a unit of time, and from one single phenomenon we could get two units. But when the absolute system was established, wave length and wave rate was not understood; and if you will consider the thing for a moment, you will see that it is almost impossible to think of any absolute unit—anything that will be as true in Asia as it is in America, and also as true a thousand years hence as it is to-day. That is what an absolute system requires. They simply selected the best absolute unit they could get, and they were forced to take a unit based on the size of the earth. But this is not a good unit on account of the difficulty of measuring the earth. It is so large that it is extremely difficult to measure it. The first question in this system of absolute units is, what units have we got to determine. This is largely choice, and it so happens that if we fix a few units we fix all the others. The others can easily be derived. The three facts in nature which are supposed to be absolute, and that philosophers look upon as the three fundamental conditions of existence and thought, are time, space and matter. These three facts are supposed to be fundamental, and everything else is a combination of them. This may be true, or it may not be true; but so far as matter is concerned, it is a question whether there is such a thing at all. It is impossible to know of it directly. We only know of matter through force. For instance, when we take a brick—one of the most tangible things we can think of—the reason we know that it contains matter, or think that we know that it contains it, is that it is rigid, which is entirely due to the force of cohesion of its particles. One can quibble about this forever as with most other metaphysical questions, and it really does not make much difference either way. The existence of matter may be somewhat questionable, but of course there is something there that we can call matter, and we know there is time, and we know there is space.

Therefore, time, space and matter were selected as the fundamental quantities, and it was necessary to find a unit for each.

Taking space or length, which amounts to the same thing, as the first, they began by measuring the circumference of the earth, or, rather, a quarter of it—the earth's quadrant—which is the distance from the pole to the equator. Of course, the actual distance from the pole to the equator was not measured; they measured one degree of it, and calculated from that. These measurements were carried on with the utmost care. It took months and months of the most careful work to make them. The metal bars were laid on the ground perfectly horizontally. The temperature had to be carefully taken. The bars had to be exactly in contact, that is just touching each other—not enough pressure to produce any strain. It would probably take days to travel a few hundred feet, and to travel 60 miles and make an exact measurement of that sort and expect to come out within a few inches, would require exceedingly careful and protracted work. Unfortunately, an error was made that would not be of consequence in anything else, but in the case of a foundation of a system of units it amounts to something—about one one-hundredth of one per cent Nevertheless, from that measurement the unit was determined. But the question arose, what fraction of the earth's quadrant to take as the unit. Of course, it must be a round number. A ten-millionth happens to be about equal to a yard. A one hundred-millionth would be too small—about four inches. One is a little too small and the other is too large a convenient unit of length. The foot, which is a very convenient unit of length, is between the two, but unfortunately the earth didn't lend itself to this system of units. They chose the larger one, and made the meter the standard of length. The meter is simply one ten-millionth of the earth's quadrant, as measured by the French authorities. They made exact copies of it, and deposited it in Paris, which is the center in regard to metric matters, and the various national governments are supplied with exact copies of the standard. An exact copy was sent to the United States not much more than a year ago. It was opened by the President of the United States in the presence of the officers of the government, and was a matter of considerable importance.

Having the meter, the question was to get a unit of weight. The unit of weight may easily be gotten by cubing—that is, making a volume from the unit of length and filling it with water. But a cubic meter of water would, of course, be too large for a unit of weight, as it weighs about a ton, so a fraction of it was taken Here again a choice was necessary. A cubic centimeter of water was selected and called the gramme. I think that was a great mistake, because a centimeter is a very small thing, and has tended to bring the whole system of absolute units into disrepute. It seems so small that it is not worth considering. I think if they had taken the decimeter, the tenth of the meter, as the unit of length and the cubic decimeter of water as the unit of weight we should have very much better and more harmonious units. A meter is too large, and a gramme too small. The unit of time has already been selected. The second is simply the ordinary second that is used in calculating time all over the world and is also a very small unit. Thus we obtain the three primordial standards of length, mass and time, and since, for scientific purposes, the centimeter is taken instead of the meter, we have the centimeter, gramme and second as the three fundamental units upon which is based the C. G. S. system of units. Theoretically, and probably practically, all units of every kind, present and future, can be derived from these three simple fundamental units, which we can all understand and know just how they were obtained, and what their values are. The mechanical units are very easily derived from the fundamental units. To obtain velocity, we divide length by time, that is to say, we do the same as in any other case, when we say so many miles per hour, so many feet per second, etc. Acceleration, of course, is the increase of velocity. That is to say, it is distance divided by time, which is velocity, and that divided by time again, because if we increase the velocity in a certain time, that is acceleration. Force is giving acceleration to a mass, which is the Newtonian principle of measuring force. Work is simply force multiplied by distance, which again is well known To take one pound and lift it two feet requires two foot-pounds, and so on. The electrical units are almost as easily derived, but the question is what to start with.

There are two fundamental laws of electricity. One is

[1] Address before the New York Electric Club, December 18, 1890.

Coulomb's law, which applies to static electricity, and states that a certain charge of electricity attracts or repels another certain charge with a force directly proportional to the product of the quantities, and inversely proportional to the square of the distance. In former times static electricity was very important. The old books were full of dolls with hair standing on end, pith-balls, etc. It happens now that static electricity does not amount to much. There is no force in it. A spark passes and that is the end of it. We need something more constant than that. So when electricity is to be used, it should be in the form of current which lasts. The fundamental law of the electric current is that of Ampere, which states that a current affects a magnet in proportion to the strengths of the magnet and of the current, the length of the wire, and inversely proportionally to the square of its distance from the magnet. As we can measure the length of the wire and the square of the distance, hence we can get the strength of the current. But this involves having magnetic units. Here are two bar magnets supposed to be exactly alike. If I bring the north poles together they repel each other; and if the magnets were delicately suspended on silk fibres, and brought within a unit's distance, and the repulsion between them accurately measured by the torsion of the fibre or by balancing them against some other known force—a delicate spring—then I would find how many units of pole strength the magnet had. To get a unit magnetic field from this we say that a unit pole placed at a unit's distance produces a unit's strength of field. The field is the thing important in dynamo machines and many other practical cases.

To get a line of force, which, by the way, is the unit that is most used in practice, we produce unit field and take a unit's area of it, which is called line of force. It is to a certain extent arbitrary, but it is definite, nevertheless, and that is the line of force that we use so much. We read of it in text-books, and even in the daily papers.

To return to measuring the current. We take a unit pole and when it has a unit of force exerted on it by unit length of a current at a unit's distance and a unit length, then it is a unit current. Thus we pass from the quadrant of the earth to the unit of the current by several simple steps, each one of which is easy to understand and each one of which is perfectly logical and follows directly from the previous one.

From current, which is, in my opinion, the fundamental unit of useful electricity, we obtain quantity of electricity. Quantity of electricity is simply the amount of electricity that flows in a unit current for a unit time. Now, electromotive force is about the most troublesome one of these units. It means the tendency for electricity to produce a current and do work. Therefore, electromotive force multiplied by quantity of electricity would give you the work. If I have a certain electromotive force and one unit of quantity I will have a certain work that will be measured by the electromotive force. It is exactly like steam. I can have 100 pounds' pressure of steam and one cubic foot of steam; I will have a certain amount of work If I have two cubic feet of steam at the same pressure I will get twice the work. Conversely, if I have 50 pounds' pressure and two cubic feet I will have the same amount of work practically—a little less in the case of steam—as if I had 100 pound pressure and one cubic foot. In other words, the products of the pressure or electromotive force by the quantity is the work. Therefore, to get the electromotive force divide the work by the quantity.

Ohm's law gives the resistance as equal to the electromotive force divided by the current, these last two being known. From here on the derivation of the rest of the units is a mere clerical matter. For example, taking capacity as the next unit, we find it equal to quantity divided by potential, that is, the unit of capacity will hold a unit quantity at a unit potential. Work, as I have already explained above, is equal to potential times quantity. Power is rate of work: Therefore potential multiplied by current, quantity per second, is power.

We come now to self-induction.

Self-induction is somewhat unfamiliar, nevertheless, it is becoming important. Self-induction in telephone work, aerial, underground and submarine lines, dynamo armatures, dynamo field magnets, transformers and other alternating current apparatus, are all practical cases of self-induction. We should consider self-induction almost as much as resistance We have not done so heretofore, but that is no reason why we should not in the future.

It happens that there are several ways of defining self-induction, but the best way, I think, is to consider it as a counter electromotive force. That is to say, when I send a telephone current through an electro-magnet the latter reacts against the current. When the current tries to go through, the magnet tries to oppose it. Therefore, the best way to define the unit self-induction is to say that it gives a unit counter electromotive force when there is a unit change of current in a unit time. The ordinary way, however, of deriving this unit is to multiply resistance by time. That seems to be an odd way of getting at it, but what it means is this: That self-induction is the apparent increase in resistance that we get when we try to pass a current through a circuit. If I put a current through the field magnet of a dynamo machine, it will take some time before it reaches its full strength. The magnet will resist the current very much more than the mere resistance of the wire, if it were stretched out in a straight line, due to the fact that it is formed in a coil around a piece of iron. But after the current got flowing, so to speak, then self induction ceases to exist. It only occurs when a change is taking place.

The absolute units have no names, they are simply designated as absolute units of electromotive force, resistance or quantity, as the case may be. This means that they are derived directly from the centimetre, gramme, and second, and "dimensions" of units are mathematical ways of expressing how these fundamental quantities enter each unit. Some of them involve all three of these quantities, some involve two, and some only one. Take, for instance area. Area is L square, that is, the square of the length; for example, a foot square is an area. Volume is L cube Velocity is L divided by T. That is, it is L multiplied by T to the minus one power. This enables us to put them all on the same line for convenience.

We come now to the practical units. Every one of these absolute units, derived, as I said, are either so small or so big that they are not useful.

It was necessary to take a certain number of a fraction of an absolute unit. In the case of resistanee they took such a number of absolute units in round numbers as would most nearly approach the Siemens unit which had been used before and it happened to be 10^9 absolute units, which means that a billion of these little bits of absolute units will make one ohm the practical unit of resistance. naming it after the discoverer of Ohm's law and establishing the precedent of naming all the electric units after distinguished electrical scientific men, which rule has been followed without exception to the last unit. They call 10^8, that is, 100,000,000 absolute units of electromotive force, a volt. That approximated most closely in round numbers to the Daniell cell which had previously been used as the unit of electromotive force. They selected the nearest units to the two units already in existence, and having fixed those, theoretical value of the ampere followed. It is one thing to select how many practical units you will have in one practical unit and it is another thing to determine it. The whole system could have been originated without making a single experiment. The ampere can be determined experimentally very much more easily than the volt or ohm, as I said, by balancing the effect of the current on the magnet with some known force. Now, it happens that we know the force of the earth's magnetism. It is not at all difficult to find out by suspending a magnet, determining its time of swing and moment of inertia. Having determined the earth's magnetism, all you have to do is to balance the current effect on a magnet with the earth's effect on it, and knowing the earth's effect we know the current's effect and, therefore, know the value of the current, which is the whole principle of a tangent galvanometer.

Thus the tangent galvanometer will give us the value of the current in absolute units and if we take 10^{-1} of these we get the value in amperes. This is because the volt is 10^8 and the ohm 10^9. Therefore, dividing one by the other, in Ohm's law, we obtain 10^1. Having arrived at the current absolutely, we can also determine how much metal a current will deposit. But we cannot calculate it absolutely, however we must determine it. I have here the exact weight of silver that one ampere will deposit in one hour. It was carefully weighed by the assay department of the School of Mines, and it is right to the tenth of a milligramme and weighs 4.0248 grammes. The ampere is a unit that is easily determined. The volt and the ohm require laborious work of years, and the original ohm as determined by the British Association committee, was about $1\frac{1}{4}$ per cent. wrong, which is a pretty bad mistake for a scientific measurement.

In making actual standards of these units, the volt is the most elusive one of all. The tangent galvanometer and the silver deposition give up the ampere pretty well, and for the ohm we have a definite coil. But the volt is dependent on standard cells containing chemicals that are very apt to change. They are compounds, and they are apt to decompose or change in their composition.

It happens that the unit of capacity, the farad, is a very large unit and we have to take a millionth of it to get a working unit. The microfarad is the standord and it is a pretty good sized standard. It is equal to the capacity of two or three miles of the Atlantic cable. It would contain the same quantity of electricity as two or three miles of Atlantic cable, and it would take a thousand Atlantic cables to equal one farad in capacity. Therefore, you see that what is called the "practical unit" of capacity is very impracticable. The reason the farad is so large is that we have obliged ourselves to define units in terms of one volt, one coulomb, etc. Now, with static electricity, one volt is very small. Our ordinary static charges are 100 000 volts or more; for instance it takes about 100,000 volts to spark one inch.

Now a static spark to jump an inch is not a particularly large one. These, to take the volt to determine the unit of static capacity, make it necessary to have a tremendous capacity to hold our coulomb at that very low electrical pressure.

I would like to point out that we have "absolute units" and "practical units," so called. I put both of these in quotation marks. Absolute units, as I have said, are not absolute; they are based on an arbitrary dimension of the earth incorrectly measured. Now, practical units in the same way are not practical, because we have one, the farad, that is 1,000 times greater than the greatest practical capacity in existence. Therefore, I maintain that we must have a third system of units, and that is the "working" units. You could call them "commercial," but the objection to that is that they are equally used in the laboratory as in commercial work. We use a microfarad in the laboratory the same as in the office of a telephone or cable company. Therefore, they are not, strictly speaking, commercial, but they are *working* in both cases. Sometimes the working units agree with the practical and sometimes they do not. The ampere, coulomb and volt are the same, although in telegraphy we use the milliampere. Then we come to the ohm. That is, the ohm is right for most practical work, but for insulation tests we have to use a megohm. Nobody thinks of giving insulation tests except in megohms. Therefore, for that class of work, the working unit is the megohm, and not what is called the practical unit.

When we come to the microfarad, there is no question. The practical unit ceases entirely to be practical, and we have to adopt the working unit, which is almost entirely different.

The watt is a convenient unit for a great many purposes, but when we use it for large work we use the kilowatt, which, by the way, is a good way of rating dynamos, because it is fairly near a horse power.

Then we come down to the last of all—the henry, the new member of the family, and it is a question whether the working unit will be a henry or a millihenry. I did think of reducing the value of the henry to $\frac{1}{1000}$ of its value as given in the table; but it would have been a mistake, for the reason that, instead of having its value one second multiplied by one ohm, we would have its value one second multiplied by a thousandth of an ohm, or a hundredth of an ohm. That would be destroying the simplicity and the harmony of this system—a feature which it certainly does possess. Every one of these units is derived from every other one in the simple ratio of one to one, and in no case is there a complex relationship of a thousandth or ten thousandth or anything of that sort. You see that the coulomb is an ampere multiplied by a second, a volt is one ampere multiplied by an ohm, a farad is a coulomb divided by a volt. A joule is a volt multiplied by a coulomb, and a henry is a second multiplied by an ohm; and to make any one of them anything else, would, I think, be a mistake, particularly as it would have been the only exception to the harmoniousness of the system.

Fortunately, the henry approximates a practical value. For example, a large Edison dynamo, shunt wound, will run up to one or more hundred henrys. A telephone magnet will be between $\frac{1}{100}$ and $\frac{1}{10}$ of a henry. We could not expect that to be a very large value. An ordinary relay is several henrys in value. A large induction coil is often 1,000 or more henrys in value. Therefore, there is nothing preposterously small or large about the henry. It is about right. I have given in the last column of the table the actual or experimental value. That is, 4.025 grammes of silver per hour is the ampere. The volt is .926 of a Daniell cell. The legal ohm is 106 centimetres of mercury one square millimetre in cross-section, etc. The unit of self-induction is equivalent to the length of the earth's quadrant. Thus we see that often starting with the earth's quadrant in this system of units, to obtain the fundamental units of length, and passing through all the mechanical units and the electrical units, we finally get back to the earth's quadrant again. It is certainly quite remarkable and striking. It is a fact, nevertheless, that the unit of self-induction is properly represented by a length equal to the earth's quadrant. In fact, it has been called the quadrant and was so called by the Paris Conference, which, I think, was a great unfairness to American electrical men, both living and dead, because certainly America's contributors to electrical science and industry have been fully equal to those of any other country, and if England has the farad, joule and watt, named in honor of her distinguished electrical scientists, if France has the coulomb and ampere, if Germany has the ohm, and if Italy has the volt, I think it is certainly not unreasonable for us on this side of the Atlantic to ask for one unit to be named after the discoverer of self-induction, Joseph Henry.

In regard to future units, which the requirements of advanced work will soon necessitate, we need the unit of the strength of a magnetic field. We can express it as so many lines of force to the square centimetre, etc., but that is a very clumsy way. If we simply call it one Franklin, it would be very preferable to a long sentence. We all have in mind the naming of some electric unit after Franklin, but, unfortunately, Franklin is not identified with magnetic work. He is identified with electrostatic work, but all the electrostatic units have been named. But, perhaps, his name may be adopted. We shall certainly require within a short time a magnetic unit defining the number of lines of force, and we will speak of a field as so many units, and we will have a name for it; and when we use it every one will know what we mean. The naming of a new unit and giving it its value and deciding what it shall be, are very difficult questions. An error might cause considerable trouble and loss of time and all sorts of bad results, whereas, the proper selection of a unit would greatly facilitate work.

This treatment of units is necessarily superficial, and all I have attempted to do is to show you the general derivation of them, starting at the very first conception and coming to the present time and a little beyond. In fact, by giving you some inkling of what the probability of new units is.

Increase in Cable and Telegraph Messages.

In speaking of the growth of New York city a metropolitan newspaper says: The increase in the ocean cable and land telegraph facilities during the decade is again indicative of the growth of the city of New York, for the entire system is tributary to and greatly dependent upon the metropolis. In 1880 there were 185,645 miles of cable in existence. In 1890 there are 283 917. The Western Union and Postal companies now control 778,597 miles of wires, against a total of 233,534 in 1880. There were 10,077 offices in operation during 1880, but their number has now been increased to 22,382. The total number of messages sent over the wires in 1880 were 39,512,904, but the total is now estimated for 1890 at 83,784,627. The receipts for 1880 were $16 827,948; this year they are $34,783,282. The profits in 1880 were $7,383,379, but during the present year they are estimated at $10,123,298. The expenses for 1880 were $8,498,293, while for the present year the estimate is $18,740,609. The expenses ten years ago were $8,498,567, and they will now reach $17,746,926.

The Western Union company has absorbed the Baltimore & Ohio wires, with others, and the Postal company has consolidated the remaining opposing lines. Few of the latter were in existence ten years ago, but the Postal now affilliates and controls the Bennett-Mackay cables, the Canadian Pacific, Commercial Union, North American and Pacific Postal lines. The Postal Telegraph company is rapidly extending its wires to the Mississippi and the Mexican border, to the Pacific, and all along the Atlantic coast as far as Nova Scotia.

The newspaper special telegrams have increased from 41,000,000 words in 1880 to more than 300,000,000 words in 1890. It is a matter of record that in 1880 there were

not more than fifty to seventy-five newspapers in the entire country that got any specials at all; now there are more than 700 enjoying this description of news service. The Associated Press, United Press and similar news organizations have more than doubled that part of the newspaper news facilities. Special wires are now owned or leased by leading newspapers, which increases the volume of business.

CORRESPONDENCE.

New York Notes.

NEW YORK, Dec. 27.—The appointment of a second rapid transit commission by Mayor Grant at this time is of special interest. The action was taken at the request of a number of influential taxpayers. The fact that an underground electric railway is now in successful operation in London is significant. William Steinway, who worked so persistently on the last commission and planned a route for the construction of an underground railway to be operated by electricity, is again on the commission. Although the efforts of the old commission amounted to little practically, still they had the effect of interesting a large and influential number of citizens. The completion of the underground railway in London in the meantime, and its successful operation by electricity confirm the belief of Mr. Steinway that electricity can solve the problem of rapid transit underground.

Louis Sterne of the Crown Iron Works of Glasgow, one of the promoters of the London & Southwark subway, has arrived in this city and will lay before the rapid transit commission the plans and general outline of the Greathead system of subway construction. Mr. Sterne reports that when he left London ten trains were running continuously at a headway of from two to three minutes, but were unable to accommodate the traffic. He says: "The tunnel and trains are electrically lighted; there is no fire or gas in the tunnel, which is as dry as a match. The air is as pure as that of the streets."

A somewhat sensational story of the execution of Kemmler is told by a discharged convict who claims to have assisted in arranging the dynamos and other apparatus for the execution. He is Charles Losee and claims to have been employed as a practical electrician by the Brush and the United States Electric Lighting companies, and for that reason was made assistant to the electrician who had the execution in charge. The statements of Losee cannot be of much value, as he has been a "crook" about all his life.

The suit of the Automatic Phonograph company against the North American Phonographic company involves the question of the sale of phonographs with the slot attachment by the former company. The Automatic company has given a $5,000 bond, with Charles A. Cheever and George S. Evans as sureties. Their qualification has been questioned, and Judge Lacombe in the United States Court has granted an order that they appear for examination.

The gas commission has agreed to accept the bids of the electric lighting companies at a rate of forty cents per lamp a night. There are 1,386 lamps to be lighted and the board of estimate and apportionment inserted an item of $60,000 to meet the expense.

The certificate of organization of the Commonwealth company was filed in the office of the Clerk of Essex County at Newark, N. J. The incorporators are George Montague, the president of the Second National Bank; Welcome G. Hitchcock of New York, and William J. Turner of Millington, N. J. As Mr. Turner's name often appears in connection with the Westinghouse interests it is assumed that the other interest is represented by the Westinghouse capital. The capital of the company is $250,000 paid in and its object is to transact a general financial business in connection with the mining interests of Colorado.

This company is said to be an important element in a syndicate to control the gold interests of a certain district in Colorado. All of the mines are now united under one control in a central organization having a capital of some $12,000,000, and the Commonwealth company will manage the financial affairs of the trust. One serious objection to the mines situated in this part of Colorado has been the lack of proper fuel and the great cost of procuring it. It is now proposed to use electricity as a motive power.

W. H. T.

Cleveland, O.

CLEVELAND, O., Dec. 27.—A decision in the prolonged litigation between the Accumulator company of New York and the Brush Electric company of this city has been received from Judge Brown of Detroit, the recently appointed justice of the United States Supreme Court. The main details of the case are as follows. A number of years ago Charles Faure obtained a patent in the United States for a secondary battery. About the same time Brush applied for a patent covering substantially the same appliance. Instead of filing interference papers, as is customary in such cases, the Patent Office granted Faure the first patent and subsequently gave the Brush company a second patent, leaving the rivals to fight the matter out in the courts. The Electric Accumulator company, the assignees of Faure, brought action against the Julien Electric company of New York for infringing the patent and by means of dropping all their claims but one obtained a judgment against them, whereupon the Accumulator company filed a petition praying that the Brush patent be adjudged void on the ground of its interference with that of Faure. After the proceedings had been in progress for a time the plaintiffs wished the case dismissed, but Judge Brown overruled the motion, and returned the case for a final hearing.

The Zanesville electric road is ready for business.

Despite the heavy snowdrifts all the electric roads ran on schedule time. Snow plows and salt did the work.

The work on the Mt., A. & E. P. electric road, Cincinnati, is progressing favorably. A concession to remodel the old-fashioned Ida street bridge for use by electrical cars has been obtained from the city board. When finished this will be the second electric incline plane road in the city.

Press dispatches made quite a fuss about the electric railways of Cincinnati during the snowstorms, condemning the double trolley system altogether. This was idle talk. The greatest part of the trouble was caused by an accumulation of water at depressions, partially due to a thaw and the excessive amount of salt used upon the grades, thus submerging the motors and causing short circuits upon the connections. Some of the trouble was also caused by motors plowing through deep snow, which worked its way back into the electrical parts; again, the snow carried into the cars by the passengers melted and leaked through the floor. The trolley, whether double or single, is not responsible for the irregularities. The burn-outs were not caused by too much current, as was charged by Cincinnati papers. During the storm only two of the eight generators were in operation. As the cars were running slowly there was little or no demand for current. Individual cars may have taken an excessive amount of current at times when they were plowing through heavy snowdrifts.

The Fletcher & Fletcher company has recently secured the agency for the Card motor and dynamo.

The Brush company is devoting a large share of its attention to the production of the outfit of the Short Electric Railway company, whose palace cars attract a good deal of attention. One of these cars, which is now exhibited, cost $10,000.

R.

Pittsburg, Pa.

PITTSBURG, Dec. 27.—A. J. Waring of the Standard Underground Cable company of this city left for New York last night. He will sail for Paris in a few days to look after the erection of a large plant there for the manufacture of underground cables for the French government. The latter is placing the telegraph lines under its control, under the ground.

When the plant is completed it will be able to turn out about one million five hundred thousand dollars worth of cable per year. The company is also negotiating for the building of a plant in Berlin, Germany.

Since December 27, 1889, fourteen deaths have been caused in this city by rapid transit, and it is remarkable that thirteen of these deaths occurred on lines where the cable car is being used, while only one person was killed by an electric car. In the latter case, however, electricity had nothing to do with the accident as the unfortunate victim fell beneath the wheels.

To overcome a great deal of the danger of rapid transit, a citizen of Allegheny has recently obtained a patent for a new device which, he claims, will make it almost impossible for a street car to run over anybody. This invention is a pilot or fender fastened to the front of the car in a manner similar to the pilots now in use in the front of cable cars. It differs from the old ones, however, in that it extends from the bed of the car to the track, and reaches back a sufficient distance to cover the wheels. The inside is a mass of springs, which work automatically. The pilot is balanced so as to yield when coming in contact with a person or any other object on the track in the front of the car. Provision is also made for its yielding upward on an incline, and also lengthwise of the car when a heavier object is struck.

The operation is simply that when a lighter object is struck the fender or pilot will yield upward, but if a person or other heavy object is struck, the pilot will drop to the rails, and the obstruction will be thrown out clear of the wheels.

The fender has but a slight movement, in an inclined direction and when it comes into contact with an object, either heavy or light, the fender will rise upward and on an incline upon the frame at one side, only that side which is struck, and at an angle corresponding with an angle to which the rods and springs are disposed, and the movement of the frame to which the tender is attached, being in a horizontal direction and lengthwise, all strain upon the rods is removed and will therefore yield and not strike a solid blow.

This device is to be tried on some of the local roads in a day or so, and if it proves to be as satisfactory as the inventor claims it is, then the new pilot is to be generally adopted on the street cars in this city and Allegheny.

E. H. H.

Minneapolis, Minn.

MINNEAPOLIS, Dec. 27.—Thomas Lowry, president of both of the Twin City Street Railway companies, says that no consolidation of the corporations is or has been contemplated. A rumor to that effect recently in circulation was based upon the retirement of Col. Barr from the management of the St. Paul system, and the election of C. G. Goodrich in his place. Mr. Goodrich is also manager of the Minneapolis system, but the two corporations remain distinct and separate. Mr. Lowry also gives out the information that propositions made by the Minneapolis company to the Medicine Lake & Golden Valley and the Robinsdale Electric Railway companies for the operation of the latter lines, were rejected. Construction matters on these lines are in *statu quo* for the winter, but will be resumed as soon as the frost is out of the ground.

It begins to look as if the Twin City electric lines were to have no test with the snows this winter. The streets are still clear and the new lines run like clockwork. They are having wonderful patronage. Street car travel is fully double what it was on the horse car lines. The transfer system undoubtedly has much to do with the increase, but neatness of accommodations and rapidity of transit are important considerations. The people of the two cities are delighted with service on all lines which are complete. The travel on the interurban line does not diminish, and new motors are constantly being added to the equipment.

Joseph Gluba has brought suit against the Great Northern Railway company for $5,000 damages. He owns property abutting on Washington avenue where the new Great Northern bridge is going in. This suit is of importance to the Minneapolis Street Railway company, because, with others of a similar nature, it will prevent the completion of the bridge and consequently retard the work of the railway company. Every car line leading into North Minneapolis crosses at that point and the inconvenience is considerable. It is impossible for the company to establish any time schedule, and the operation of many lines is deranged in consequence of it.

Chas. T. Chapman, as guardian of an eleven-year-old son, has brought suit against the Minneapolis Street Railway company for $5,000 damages, which, it is claimed, the boy sustained by collision with an electric car negligently handled. The accident occurred in October.

A costly miscalculation has been made in the equipment of the interurban electric line. The 30 motor cars designed for its equipment are too high to go under the Chicago, Milwaukee & St. Paul company's viaduct over Washington avenue. Until this trouble is remedied the miscellaneous assortment of cars now in use on this line will have to be continued. It is thought the grade of Washington avenue at that point will have to be lowered fourteen inches.

The infringement suit of the Adams Electric company of St. Louis against the Thomson-Houston and Sprague companies, excites no apprehension here. It arouses much interest, however, in street railway circles, as the two latter companies have furnished the entire equipment of the Twin City lines. The railway companies are protected by heavy bonds, and therefore give little serious attention to the matter.

A. C. Bowe, a Minneapolis electrical engineer, has been arrested for wiring a building without permit.

Jacob Moore, a St. Paul brick builder, was killed by a University avenue motor Saturday. It is not yet developed where the fault was, if any existed. This is the second fatality of the kind since the electric lines have been put in operation in the Twin Cities.

W. D. Morse, formerly with the Northwest Thomson-Houston company of St. Paul, has established electric supply and construction works at Seattle, Wash., in company with F. A. W. Hammond of London, Eng., and G. B. Ellison of Cincinnati. Mr. Ellison has been connected with the Brush Electric company for ten years and Mr. Hammond was with Ferranti in London.

The Edison Light & Power company has installed about a hundred and fifty of the Ward arc lamps in this city, thirty-three of which were placed in the main power house

of the street railway company. Among the isolated plants recently installed by this company, is one of 400 incandescents at the sawmill of the H. C. Akeley Lumber company.

N. O. F.

Louisville, Ky.

LOUISVILLE, Dec. 26.—The New Albany Electric Lighting, Heat & Power company of New Albany, Ind., has filed articles of incorporation. The incorporators are: M. V. Mallory, Paul Reising, Solomon Ruthenberg, John Rauschenberger, W. A. Loughmiller, John S. Briggs and Marcus Ruthenberg. The capital stock is $100,000. Property has been purchased and contracts for buildings have been awarded. There will be no trouble in getting the right of way along the streets from the city council, it is thought.

Campbell Scott, who was in charge of the motor and mining department of the Edison General Electric company's branch office here, has gone to Cincinnati to take charge of a branch office.

The New Albany, Ind., Gaslight company has one dynamo for lights in successful operation, and a second machine will be installed at once. The third will be received in a few days.

The ordinance providing for lighting the business portion of this city by electric light by contract with the Louisville Gas company, has been referred to the finance committee in the General Council for the tenth time.

The Postal Telegraph company will be ready to begin business here January 1. The company now has its wires at Fourteenth street, but has to secure from the general council the right of way along Water street to Third street, and thence to the office at Third and Main streets.

At Memphis, Tenn., Saturday, the city council at a special meeting, passed an ordinance ratifying the long disputed contract with the Consolidated Street Car companies of that city, which were purchased about a year ago by a syndicate of capitalists, headed by C. B. Holmes of Chicago, for $1,000,000. The company engages to substitute electricity for mule power, and will make the change not later than April 1, next.

The new Louisville & Jeffersonville bridge across the Ohio river will be completed not later than August 15, next. A. Banzand, a large stockholder, who is also interested in the firm building the bridge, has said that the Jeffersonville street car system will be purchased and that an electric plant will be put in at that city. The cars will be operated over the bridge by electricity and the system will be similar to that now in operation in St. Louis, except that the cars will run to the business centers as well as over the bridge.

J. W. L.

Lincoln, Neb.

LINCOLN, Neb., December 26.—By the fifteenth of next month Lincoln will be a well lighted city. The municipality has contracted with the Lincoln Electric Light company for sixty electric lights, sixteen of which will be burnt all night. The city will pay $10 a month for half-night lamps, and $15 for all-night lamps, making a total monthly expense for electric light of $680.

Work has begun on transforming the Capitol Heights line into an electric system, workmen being now engaged in erecting poles for wires and bonding the rails.

The line runs in close proximity to the Catholic and Nyuka cemeteries and Union college. The line will be running to these places within a few months. This done, only one block remains at Thirteenth street, between N and O, to connect the Capitol Heights and City electric lines, making fully twelve miles from Southeast Lincoln to Grandview and the Episcopal college in north line.

A short time ago the North Lincoln Electric Street Railway company made a bold dash for the possession of right-of-way along the western extension of A street toward Cushman Park, evidently to head off the Lincoln Street Railway company which had already put in a track across Salt creek on that thoroughfare, just west of First street The electric people put down double tracks on A, between First and Second, just east of the bridge, and on First and Second between A and B. The ordinances provide that no more than two tracks shall be permitted on any street, and the electric people expected that by putting down two tracks themselves they would prevent their competitors from putting down any and thus render it impossible for them to secure a connection with their uptown lines. Recently it was discovered by the Lincoln City railway people that the North Lincoln people had not laid their tracks in the center of the street. They had located the double track with reference to the Salt creek bridge, which is on the section line. The North Lincoln had not made allowance for the jag, and their track was therefore not in the middle of the street. The Lincoln City people therefore proceeded at once to quietly lay track along the center of the disputed street parallel to and about twenty feet north of their adversary's tracks, since which time work has been actively prosecuted in the building of the proposed Southwest extension.

An ordinance has been passed calling a special election for the purpose of granting a franchise and right of-way through the streets of Lincoln to the Lincoln & Lake Park Electric Railway company.

The capital stock of the new company is $250,000. The incorporators are: Geo. E. Bigelow, J. H. McMurty, K. K. Hayden, J. F. Bush, U. B. Comstock, G. A. Bush and D. L. Boace.

Des Moines, Ia.

DES MOINES, Dec. 25.—The new station of the Des Moines Edison Light company, but recently completed and occupied, is a model of neatness and beauty. The capacity of the station is about 10,000 lights at present, but in planning the building, room has been left in every department for doubling this capacity. The electric current is obtained from six powerful dynamos, which are run by two Williams' compound condensing engines and a Buckeye engine. Especial care has been taken to protect the three boilers from becoming filled with sediment. The water used is taken from the river, filtered through cobbles and gravel to a large cistern, thence through charcoal filters to two auxiliary boilers, where it is heated to boiling heat, and from these boilers it runs in an absolutely pure condition to the boilers proper. The switch boards are beautiful specimens of artistic work. The street system of the company was wholly rebuilt last year. The plant, including the real estate, buildings, machinery and street system, has cost thus far $150,000.

The city council of Ft. Dodge has under consideration a proposition for the sale of the electric light plant of the Thomson-Houston Electric Light company in that city to the city. If the deal is consummated the plant will be operated in conjunction with the waterworks plant, now owned by the city.

The Avoca Electric Light & Power company is progressing finely with the work of getting the plant in operation. The power house is finished, and the work of setting the poles has commenced. Afton also has quite an extensive plant nearly completed, to be owned and operated by the city.

The Clinton Electric Railway company, recently organized and whose system is to be completed during the coming summer, has been induced by the successful use of the storage battery system in other cities, to reconsider its intention to use the overhead wires, and will operate its cars by storage batteries.

F. M. C.

THE ELECTRIC LIGHT.

The Hagerstown, Md., Electric company has increased the capacity of its plant.

The Brush Electric Light & Power company, Savannah, Ga., will put additional machinery in its electric light plant.

A stock company will be organized at Rome, Ga., it is stated, for the purpose of erecting a new electric light plant.

George Swan, R. R. James, E. G. Roberts and others of Clifton Forge, Va., are endeavoring to organize a stock company to erect a $25,000 electric light plant.

The Westinghouse Electric & Manufacturing company is now installing a central station alternating current electric lighting plant at Berlin, N. H. The plant will commence operations with 750 sixteen-candle power lights' capacity.

The Arkansas Pass Electric Light & Power company of Arkansas Pass, Texas, which only a few months ago started on a plant of 500 alternating current incandescent lights, has already made the experience that electric light is what the people want, and that they will have it. Hence the company has also added an arc light plant to its central station. The apparatus operated is of the alternating current system of the Westinghouse Electric & Manufacturing company of Pittsburg, Pa.

The incandescent electric light is rapidly supplanting the gas lamps in the West. The Keokuk Electric Light & Power company, of Keokuk, Ia., after having established a central station electric lighting plant of the Westinghouse alternating current system last year, has just made another contract with the Westinghouse Electric & Manufacturing company for the supply of two dynamos; with this addition, the Keokuk plant will have a capacity of 2,250 16-candle power lamps.

The present Board of Aldermen of Fairbury, Ill., has made a contract with H. A. Foster & Co. to furnish Fairbury with electric light for five years, the company to use arc lights on the streets in the business portion and incandescent throughout the residence part. The board also has passed an ordinance giving Foster & Co. the exclusive right to erect poles, wires and such other appliances in the streets of Fairbury as are necessary to an electric light plant. The question of the power and right of the board to grant exclusive franchises is being discussed by the citizens, and so far the sentiment seems to be evenly divided. C. C. McDonald has started a plant, and is now furnishing some of the business houses with his light, which Foster & Co. are threatening to stop through an injunction. The outlook, therefore, for a long and bitter legal fight is good.

The Louisville Electric Light company of Louisville, Ky., has just contracted with the Westinghouse Electric & Manufacturing company for the third increase in the capacity of its alternating current central station electric lighting plant. The company commenced operations about two years ago with a plant containing Westinghouse alternating current apparatus of fifteen hundred lights' capacity. With the latest addition of two 1500-light Westinghouse dynamos the plant will have a total capacity of 6000 sixteen-candle power incandescent lamps.

THE ELECTRIC MOTOR.

Efforts are being made at Fort Worth, Tex , to organize a stock company to build an electrical street railway to Brooklyn Heights.

The Southern Electric Car company of Roanoke, Va , has been organized to build Black electric motors. The capital stock is $500,000.

The Oxford Lake company has decided to issue $75,000 of bonds to change its dummy line to an electric road, and extend it through Anniston.

It is stated that New England parties are endeavoring to secure a controlling interest in the Charleston, S, C., City Railway company, with a view to converting its lines to electrical roads.

The Union Passenger Railway company of Baltimore, Md , has secured control of the Baltimore, Catonsville & Ellicott's Mills Passenger railway and intends introducing some method of rapid transit. An electric system will probably be adopted.

Residents of East St. Louis are clamoring for a 5-cent fare over the Eads Bridge Electric railroad from Third and Washington avenue, St. Louis, to East St. Louis. An officer of the company was asked when this would be granted. He said: "When East St. Louis has 100,000 people. You see the contract between the bridge electric railroad people and the Eads Bridge company is a peculiar one. Under it the railroad pays over 40 per cent. of its gross receipts, and they can't get enough passengers at present to enable them to pay expenses at 5 cents. But I wouldn't be surprised to see 100,000 people living in East St. Louis five years from now. Whenever there's enough business between the two towns to warrant it, the rates will come down."

The electric street car war in Ogden, U. T., has resulted in the arrest of the managers of both companies. About one week ago H. C. Gilbert, representing the Jarvis-Conklin company of Kansas City, was arrested on the charge of appropriating the newly laid track of the new company, in contempt of an order from the district court restraining his company from interfering with the work of its rival. Wednesday H. Henderson, secretary and manager of the new company was brought before United States Commissioner Perrin as a witness in a damage suit against the Jarvis-Conklin company for maliciously interfering with the construction of that company. He declined to reply to questions as directed by the commissioner, and was commited for contempt in default of bail.

The Carthage (Mo.) & Twin Cities Electric Railway & Power company has been formed with a capital stock of $150,000, one-half of which is paid up. The incorporators are Maj. W. B. Myers, Maj. H. H. Harding, C. O. Harrington, Joseph Herrin, G. D. Sleeper, C. N. Reynolds, and Albert Cahn. Mr. Reynolds resides at Webb City, all the others at Carthage. The object is to operate a street railway in Carthage, and to extend an electric road to Webb City and Carterville, nine miles southwest, and also to furnish electric power to the several mines in Carthage. The Carthage horse railway lines will probably be absorbed and made an electric line, and three miles more will be added by extension in the town. The survey to the other towns will be made at once and the work pushed as weather permits, until the lines are completed.

A dispatch from San Antonio, Tex., says: T. Delafield of New York, who e money constructed the Alamo electric car line from the center of the city to the fair grounds, is in San Antonio. He said to-day that it was his intention to immediately begin the work of extending his line, and to continue extension until the city is given another wholly separate and independent system of electrical transportation. Mr. Delafield holds three valuable franchises and his business here is to induce the council to grant the further franchises necessary to the accomplishment of his purpose. Men will be put at work before the week is out building to the cemeteries and to Beacon Hill, a northwestern suburb. These lines will be completed in ninety days. Mr. Delafield applies for right of way to all the railway depots and to government headquarters, and will expend $500,000. When his work is finished San Antonio will have more miles of electric road than any town in the South.

A new scheme in electrical railroading is about to be carried into effect in Colorado. The company interested will be known as the Denver, Lakewood & Golden Electric Rail road. The road to build and equip will cost about $800 000 and it is expected it may be completed in March, 1891. The main line is to be fourteen miles long, and a ten-mile addition is contemplated to Lookout Mountain later. The primary power will be obtained in a very novel manner. Water from the Clear Creek canyon and the Welch ditch, fed by the melting snows of the Rocky Mountains, will furnish power to operate the dynamos furnishing 1,200

horse power. The road will run through a considerable unsettled country, but the opportunities it will afford for rapid travel will, it is expected, have the result of establishing suburban districts rapidly along the line. No definite system has yet been decided on, but it is contemplated to equip each car with two thirty-five horse power motors capable of moving twenty miles an hour, and pull loaded tow cars if necessary. The overhead wire will offer the company an opportunity to furnish power to outside companies en route for miscellaneous purposes, which the directors of the company intend taking advantage of, as it will undoubtedly be a profitable undertaking. All along the line incandescent lights of high candle power will be strung. Golden, the western terminus of the road, is favorably situated at the entrance of a large canyon to the Rocky Mountains, the surroundings of which are very picturesque. This attraction will draw many tourists thither, who will use the road for traveling, a considerable source of profit to the railroad company.

An exhibition test of the Baxter electric street railway system was made on the premises of the company in Baltimore, December 27, in the presence of a large number of prominent business men. There were present at the test prominent electricians from Baltimore, Chicago, New York and Boston, and the Baltimore city council attended in a body. The test was successful in every way. A special train conveyed the visitors to the works, and luncheon was served on their arrival. The test was made in the yard of the company upon a circular track 1-16th of a mile long. The advantages claimed for the system by the inventor, William Baxter, are a noiseless action of the motor due to the slow speed of the armature, and a saving of power due to the fact that the armature is connected directly to the axle of the car. The armature of the motor, it is stated, revolves at a speed of 275 per minute. The car used at the test was fitted with two 24-horse power motors. These motors weigh 1,500 pounds. The motor is so planned that all parts are easily accessible. The gentlemen who conducted the test were Mr. Baxter and Superintendent David E. Evans. John Darley was in charge of the car.

THE TELEPHONE.

It is announced that the cable of the Paris-London telephone line will start from the French coast near Calais and terminate at Dover from which town the line will be carried overhead to London. The apparatus in Paris will be provisionally installed at the Bourse, and will subsequently be installed in the Hotel des Telephones in the Rue Gutenberg as soon as that building is completed. The telephone will be available for use both day and night, including Sunday, notwithstanding, as a French paper says, "The rigorous English custom which desires all work to repose on that day." It is believed that the charge for conversation will not be less than 20 francs for five minutes. If all goes well the line is to be opened on the 15th of February.

Personal Mention.

Gerald E. Fish, electrician of the Chicago Arc Light and Power company, has resigned his position with the lighting company to enter the electric railroad field in St. Paul. Mr. Fish is well known in and about Chicago on account of his connection with underground electrical work. His first experience with the underground distribution of high tension currents was during his connection with the old Badger company, of Chicago, in 1884. Before entering the service of the Chicago Arc Light and Power company, Mr. Fish traveled in the capacity of expert for several companies. His first position with the Chicago Arc Light company was at old "Station 5," on the West Side. Three years ago Mr. Fish was appointed electrician of the company, and this position he held until the time when he entered upon his new work. It is needless to say that all Mr. Fish's friends wish him success in his new field. On Christmas Eve Mr. Fish was presented a handsome gold watch by the employes of the Chicago Arc Light and Power company.

Miscellaneous Notes.

The H. Phillips company has been incorporated in Chicago, to manufacture gas and electric fixtures; capital stock, $5,000; incorporators, D. H. Robbin, E. F. Abbott and George S. Baker.

The Northwestern Electrical Specialty company of Chicago, capital stock $25,000, has been incorporated for the manufacture of electrical specialties; incorporators, G. L. Kirkham, H. M. Day and C. P. Chapman.

The Chicago Battery & Traction company, of Chicago, has been incorporated with a capital stock of $300,000, for the manufacture of electrical apparatus, machinery, and appliances; incorporators, Frank G. Holton, H. R. Durkee, and Edward Attield.

The Electrical Reminder company, Chicago, has organized with the following officers: President, John P. Barrett, vice-president and treasurer, George H. Bliss; secretary, George G. Carter; general manager, Joseph Angell. The capital is $25,000. The company will manufacture, sell and lease electrical apparatus for alarm clocks.

A couple of months ago says the *Shoe and Leather Reporter*, A. Zwierzchowski came from France to introduce the new method of tanning by electricity. M. Zwierzchowski made himself and his errand known to several of the leading producers of leather in New York. He was courteously received and attentively listened to, but they could go no further than to propose the application to the invention of a test which had been proposed by Jackson S. Schultz fourteen months before. This test was as follows: "Prepare two circular revolving vats. Into each of the vats shall be placed a given quantity of extract liquor, and the same number and quantity in pounds of prepared sides. In short, the conditions shall in all respects be equal. To the one vat shall be added the electric current and to the other there shall be no electric current. After revolving these vats for a sufficient time to tan the sides accompanied by electricity, they shall be taken out. If, on examination, the sides in the vat which has not had the advantages of electricity should require more time, such time shall be taken and credited to the account of electricity." M. Zwierzchowski, finding that this was the only course left to him, agreed to the conditions, with the proviso that everything should be done secretly, and that each witness of the examination should pledge himself in advance not to disclose what transpired unless he had the consent of all the others to do so. Under this arrangement the experiment was tried at the factory of T. P. Howell & Co., of Newark. The result was exactly what Mr. Schultz had anticipated. It was shown conclusively that the revolving vat which was not subject to the electrical current tanned leather as fast and as well as the other.

The cultured East seems to be inclined to prevarication. "George R. Moore, a retired mill owner," says a Lowell correspondent of the Boston *Herald*, "has constructed an electric man that walks about with every appearance of life, and is made to be useful as well as ornamental, by pushing a perambulator. The chair over which he presides is a light wicker work affair, like those of a half grown trotting sulky. There is a footboard, which is used for carrying the batteries which put the propelling power into the electric man's muscles of wood and steel. The man stands directly behind the chair. There is a pushing bar on which his neatly gloved hands rest; but this is more for vanity than utility. The action of the feet and legs is remarkable. Each foot, as it leaves the ground, rises naturally on the toe, with the same springy motion that is characteristic of the graceful walk among men and women. As in the taking of the foot from the ground, so in replacing it at the end of the step, the motion is free from jog or jar and is entirely natural. The electric man is provided with a six horse power battery, which is amply sufficient to enable him to push the fattest dowager up a hill. It is Mr. Moore's intention to make his electric man polite as well as useful, and to that end his right arm, which is said to have more joints and bones than the corresponding member of the human body, will be so arranged that he can raise his hat gracefully as he receives a fare."

Business Mention.

The Commercial Electric company of Detroit, Mich., has recently installed incandescent electric lighting plants for the following: E. S. Fitch & Co., E. J. Hargraves & Son, Green & Bramen, Edmund Hall, Rousfield & Co., all of Bay City, Mich.; P. L. Sherman & Co., of Linwood, Mich.; A. J. Douherty of Clare, Mich.; Peninsular Car company of Detroit, and is now putting in the laboratory of Parke, Davis & Co. 500 incandescent lights. Both the construction and supply departments are doing an excellent business, and the prospects for business next year are very favorable.

The Central Electric company of Chicago has arranged a new set of offices. On account of the increase of its business, the company finds it necessary to have the business so divided that each department will be in charge of some one person, who will give it exclusive attention. The president and secretary, under the new arrangement, each have private offices, which are neat and attractive. The appearance of the salesroom is also vastly improved. An unexpectedly large demand has arisen for the new Bain glass and break insulators recently illustrated in these columns. The Central Electric company has just received its first stock order of these articles, and reports that every insulator was sold before the shipment arrived. These insulators have a very practical appearance, and construction men speak highly of them. Orders for Okonite and improved Candee wires continue to multiply, and these standard articles seem to have no dull season.

The growing use of high insulation brackets for first rate line work has brought about many improvements in these excellent devices. The Electrical Supply company of Chicago, have applied for patents on a very complete new system of brackets in which lightness is combined with greater strength than was obtained in old forms. They are more convenient to apply, neater in appearance, and will prove more serviceable than the styles they supersede. The Electrical Supply company has made a great hit with the display of Geissler tube lights which they have given every evening of late in the windows at 171 Randolph street. On one side a slowly revolving tube played in and out at the center of a star-shaped reflector and the effect of the weaving and multiplying patterns was very fine, but less startling than the sudden flashing out in the other window of strange designs in mellow blending lights. Large tubes below glowed for a moment in marvelous pinks and purples. The letters "E. S. Co.," blazed up every now and then and an eccentric wheel of variegated lights spun merrily all the time. The sight was a new one to most of the numerous observers, who stopped, almost to a man, to investigate the matter.

Electrical Patents.

Issued December 23, 1890.

443,084. Electric Railway. Edward M. Bentley, New York, N. Y.

443,097. Electric Street Light. George M. Kim, Allegheny, Pa.

443,111. Printing Telegraph. Frank B. Rae, Chicago, Ill.

443,134. Printing Telegraph. Samuel V. Essick, Brooklyn, N. Y.

The first claim is given:

"In a printing telegraphic receiver, a type-wheel driven by a train of gearing, a paper-carriage having advancing and restoring mechanism, and a releasing device mechanically connected to one of the gear wheels for automatically releasing the paper carriage at any point of its excursion."

443,135. Printing Telegraph. Samuel V. Essick, Brooklyn, N. Y.

443,136. Printing Telegraph. Samuel V. Essick, Brooklyn, N. Y.

443,145. Telephone Circuit and Apparatus. James L. McQuarrie, Boston, Mass.

443,149. Railway Switch-Operating System. Samuel L. Powell, Lewiston, Md.

443,157. Electrical Signaling Apparatus. Ambrose B. Wyckoff, Washington, D. C.

The invention consists in the combination, of a dynamo or other generator of electricity, a lamp or group of lamps, a rotating shaft having projecting arms in different planes, and segments, one for each of said arms, one segment serving to direct the current to the lamp or group of lamps and the other segment shunting the current back to the dynamo.

443,167. Electrically-Operated Railway Switch. Samuel L. Powell, Lewistown, Md.

443,174. Insulator. William L. R. Emmet, East Rockaway, N. Y.

443,181. System of Electrical Distribution. Henry A. Rowland and Louis Duncan, Baltimore, Md.

443,182. Fire Alarm Box. John J. Ruddick, Omaha, Neb.

"Claim 4: In fire alarm mechanism the combination with a clock mechanism, of a detent therefor and a lever loosely mounted upon the main shaft of the clock mechanism and having a yielding connection therewith, and having a projecting portion for operating and releasing the detent."

443,187. Electric Insulator. Foree Bain, Chicago, Ill.

443,195. Cut Out. George W. Mingle, Philadelphia, Pa.

The invention consists in the combination with an electric magnet and a disengaging arm connected to line and carrying an armature and devices for disengaging this arm upon the attraction of the armature, an auxiliary armature adapted to be attracted by said electro-magnet and a ground connection.

443,219. Galvanic Battery. Horatio J. Brewer, New York.

The third claim is:

"The combination, in a dry cell, of cylinders of carbon and zinc concentrically arranged and an internal body of absorbent material."

443,224. Electric Welding Apparatus. Herman Lemp, Lynn, Mass.

443,226. Electric Belt. John L. Pratt, David City, Neb.

443,227. Mounting for Electric Motors. Andrew L. Riker, New York, N. Y.

443,237. Apparatus for Painting Electric Wires and Their Coverings. Richard W. Heppell, Dunkirk, N. Y.

443,270. Machine for Dressing the Commutators in Dynamo Machines. George P. Cummings, New York, N. Y.

443,278. Electrotype. Edward H. Hanson, Philadelphia, Pa.

443,282. Electric Safety Device for Elevators. Herbert E. Holmes, West Springfield, and Charles F. Grosvenor, Ludlow, Mass.

443,283. Electric Safety Device for Elevators. Herbert E. Holmes, West Springfield, and Charles F. Grosvenor, Ludlow, Mass.

443,291. Electro-Mechanical Central System for Regulating Clocks. Carl A. Mayrhoffer, Berlin, Germany.

443,360. Recording Pressure Gage. Jarvis B. Edson, New York, N. Y.

443,381. Telegraph Transmitter. Samuel W. Smith, New York, N. Y.

443,404. Circuit Breaker and Closer. John S. Potter, Newton and David J. Cartwright, Boston, Mass.

443,407. Dynamo Electric Machine. Charles P. Scheuritzel and John L. Hess, Brooklyn, N. Y.

443,435. Watchman's Time Recorder. Isham D. Fuller, Chicago, Ill.

443,451. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

443,452. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

443,454. Electrode for Secondary Batteries. Isidor Kitsee, Cincinnati, Ohio.

443,455. Electrode for Secondary Batteries. Isidor Kitsee, Cincinnati, Ohio.

443,456. Secondary Battery. Isidor Kitsee, Cincinnati, Ohio.

Claim one reads as follows:

"In an electrode for a secondary battery, a containing frame formed of rubber or of other material unsusceptible to electricity or to the acid of the electrolyte and blocks of active material provided with holes or apertures."

443,457. Secondary Battery. Isidor Kitsee, Cincinnati, Ohio.

443,475. Electric Cash Register. William L. Bundy, Auburn, N. Y.

443,478. Fire Alarm System. Frederick T. Fearey, Newark, and John Speicher, Jersey City, N. J.

443,487. Gas and Electric Light Fixture. Charles Felton, Denver, Colo.

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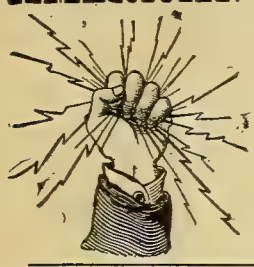

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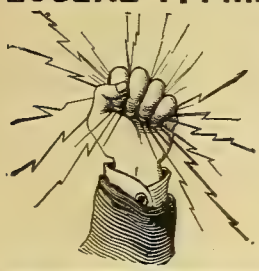

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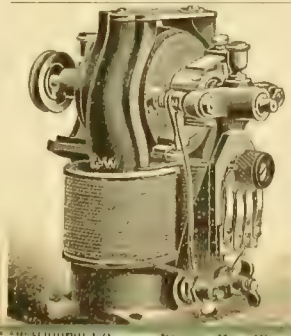

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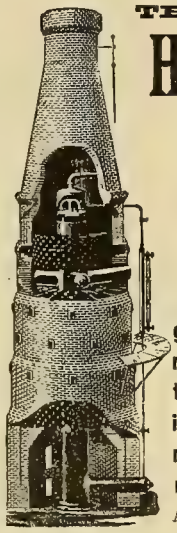

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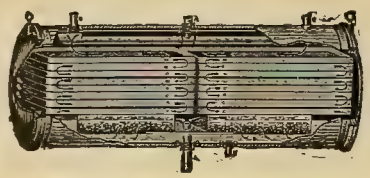

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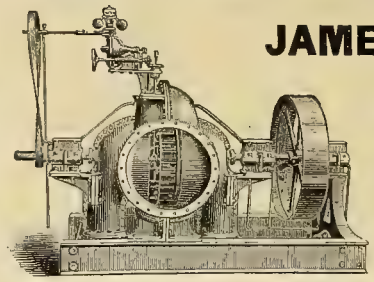

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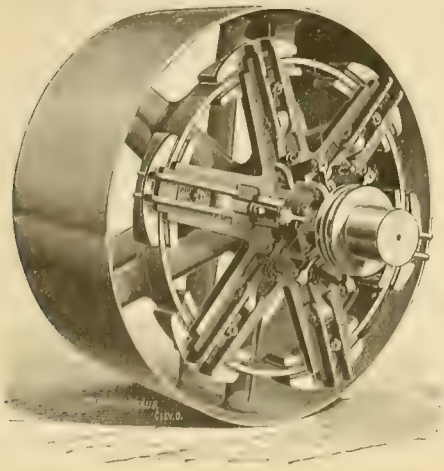

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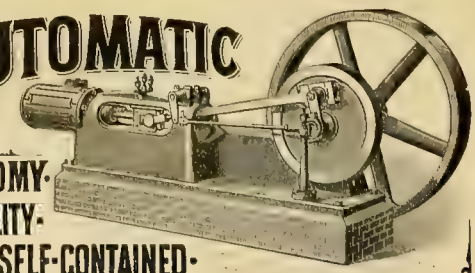

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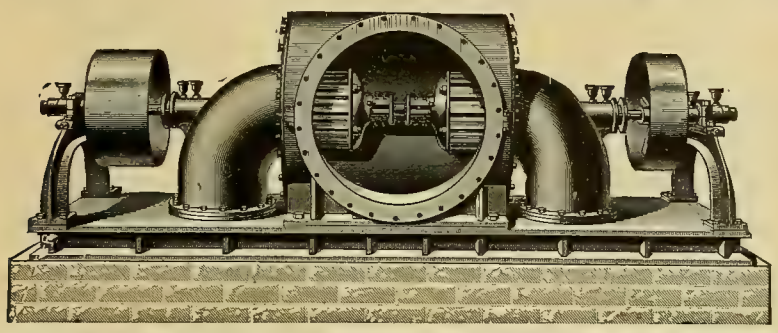

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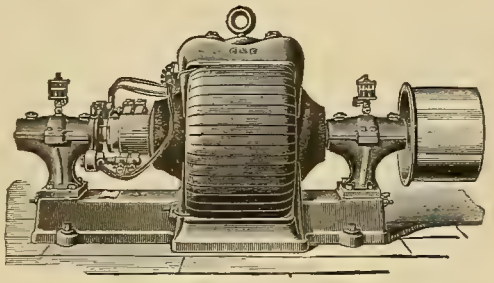

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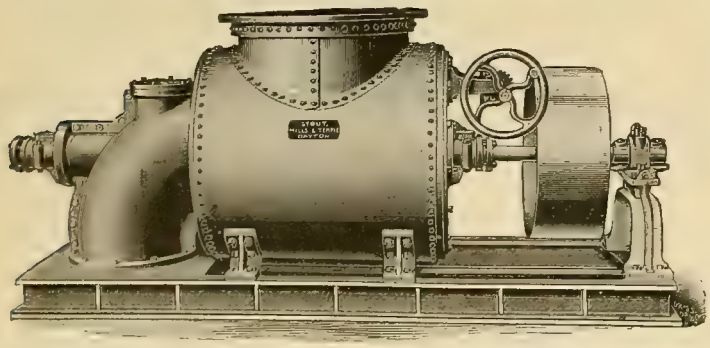

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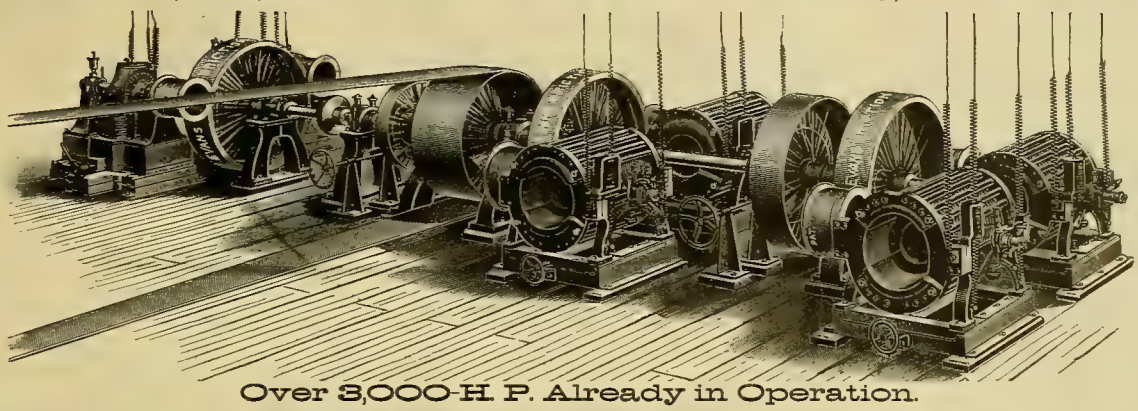

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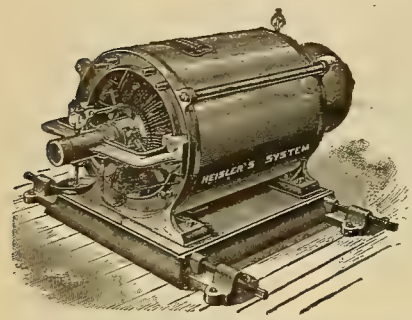

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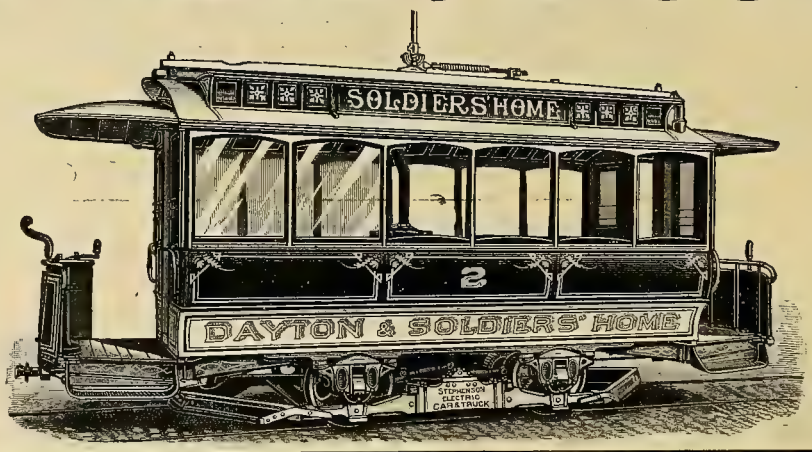

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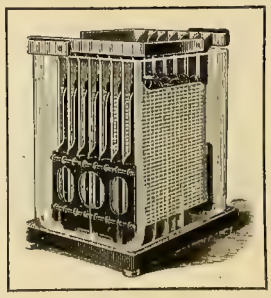

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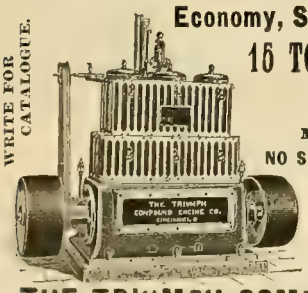

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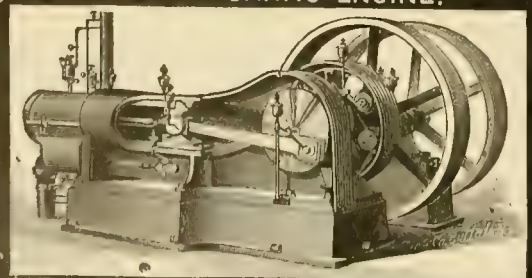

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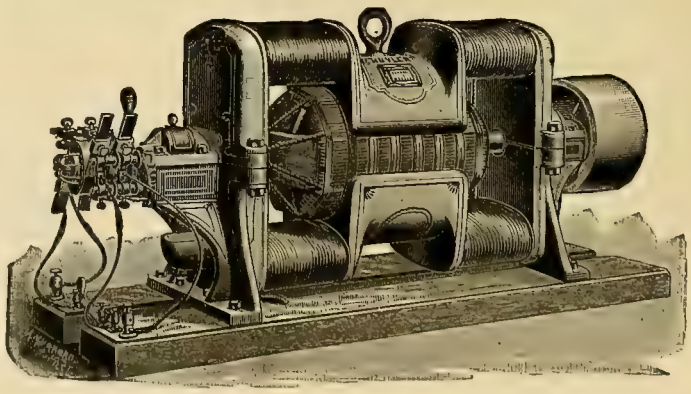

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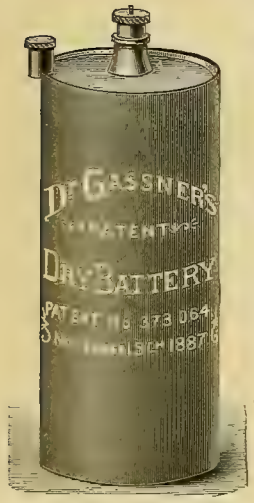

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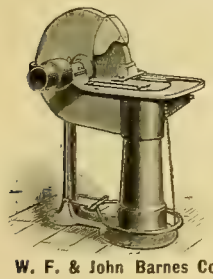

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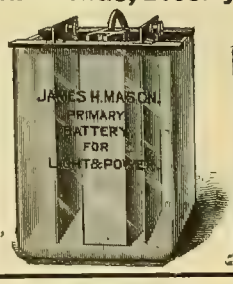

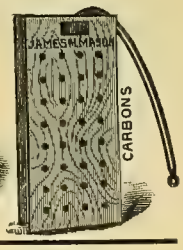

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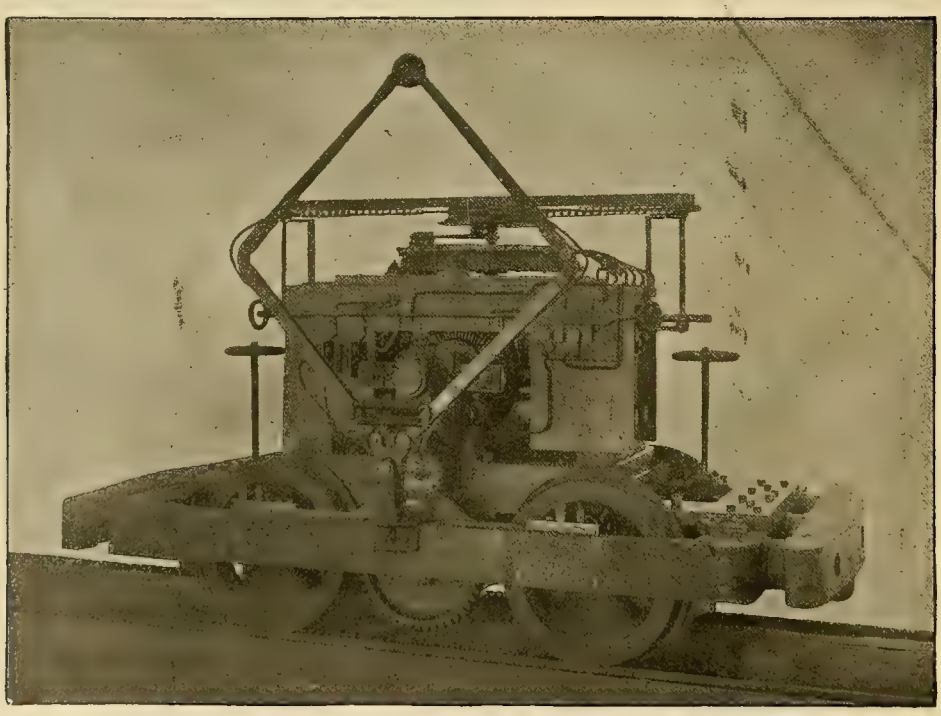

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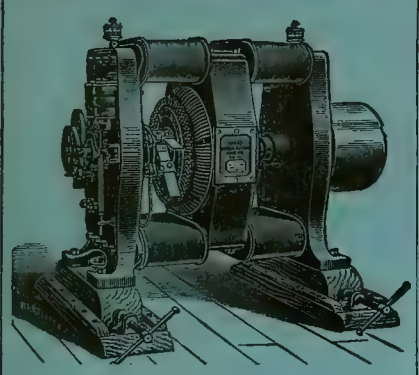

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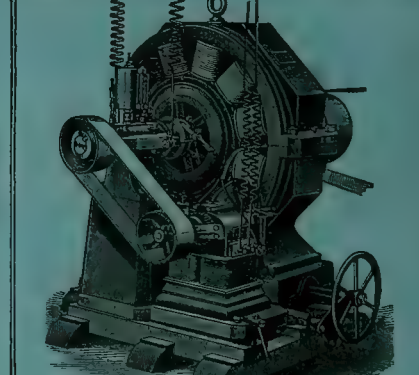

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GENTLEMEN:—This certifies that we have had your metal in use about six months on the crank pin of a four hundred and fifty horse power Wright engine, and also as packing rings on the piston rod of a locomotive. In both places it has given entire satisfaction, not causing the least trouble.

Yours very truly, C. C. MARTIN, Chief Engineer and Supt.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

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CABLES of High insulation and Long Life, all millage.

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PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

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ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

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Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,

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Fire-Proof and Weather-Proof

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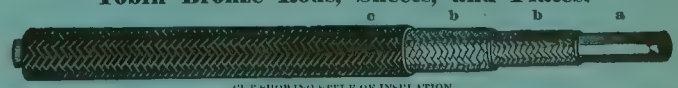

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1-2 to 36 Candle Power.

For use with Batteries or Dynamos.

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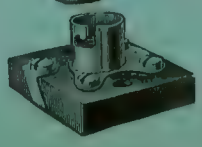

EDISON LAMP COMPANY, Harrison, N. J.

CENTRAL STATION STATISTICS

Of the Central Stations in operation July 1st, 1890, in

MAINE.	KENTUCKY.	MASSACHUSETTS.
50%	75%	$77\frac{3}{5}$%

Were using Thomson-Houston apparatus, as evidenced by the following figures.

The figures referring to "total of all systems," taken from table published in August number of "Electrical Industries," are of undisputed accuracy.	Total of all systems.	Thomson-Houston System.	
		Number.	Percentage to total of all Systems.
Maine, - - - -	34	17	50 per cent.
Kentucky, - - - -	16	12	75 per cent.
Massachusetts, - -	85	66	$77\frac{3}{5}$ per cent.

Do not be startled by these figures, but remember them and bear in mind the fact that more will be presented for your consideration next week, and that there are **11 STATES** in this country, in each of which our system is used in upward of **70 PER CENT** of the Central Stations.

WE GIVE CREDIT

for these results to our automatically regulated dynamos, noiseless and steady arc lamps, long lived incandescent lamps, and the perfected details and economical operation of our system.

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266 First Street, Portland, Ore.
831 New York Life Building, Kansas City, Mo.
148 Michigan Avenue, Chicago, Ill.
405 Sibley Street, St. Paul, Minn.
215 West Fourth Street, Cincinnati, O.
1110 Noble Street, Philadelphia, Pa.
1333 F Street, Washington, D. C.
115 North 3d Street, St. Louis, Mo.

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Consolidated Electric Storage Co.

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Cowles Electric Smelting & Refining Co.
Cleveland Aluminum Co.

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Empire City Electric Co.
Fletcher & Fletcher Electric Co.
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Holtzer-Cabot Electric Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.,
Partrick & Carter Co.
Standard Electrical Works.
Stanley & Hall.
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The Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Arc Lamps.
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Brush Electric Co.
Electric Construction & Supply Co
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
McLaughlin, Jas.
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Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

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Crosby Electric Co.
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Leclanche Battery Co.
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Partrick & Carter Co.
Queen & Co.
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St. Louis Electrical Supply Co.
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Butler Hard Rubber Co.
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Queen & Co.
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Western Electric Co.

Bells, Electric.
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Fletcher & Fletcher Electric Co.
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Partrick & Carter Co.
Standard Electrical Works.
Stanley & Hall.
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Western Electric Co.

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Jewell Belting Co.
Mason, James H.
N. Y. Belting & Packing Co
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.

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Electrician Publishing Co.

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Electrical Supply Co.
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Holtzer-Cabot Electric Co.
Jones Bros Electric Co.
Knapp Electrical Works.
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Ostrander & Co., W. R.
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Illinois Electric Material Co.
Partrick & Carter Co.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Star Electrix Co.
Union Hardware Co.
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Western Electric Co.

Dynamos.
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Bain, Foree.
Card Electric Motor & Dynamo Co
Colburn & Co., I. W.
Continental Dynamo Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
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U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

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Queen & Co.
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Bleckert & Nelson.
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Illinois Electric Material Co.
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India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
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Partrick & Carter Co.
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India Rubber & Gutta Percha Insulating Co.
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Standard Electrical Works.
Western Electric Co.
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Telephones, Electric.
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Queen & Co.
Western Electric Co.
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Trucks, Electric Car.
Edison General Electric Co.
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Thomson-Houston Electric Co.
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Dayton Globe Iron Works.
Leffel & Co., James.
Stilwell & Bierce Mfg. Co.

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American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Electrical Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Knapp Electrical Works.
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Roebling's Sons, Jno. A. Co.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

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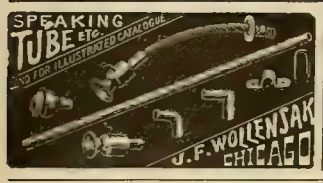

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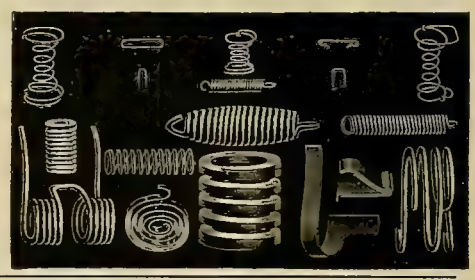
FOR ELECTRICAL MACHINERY A SPECIALTY.



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THE ONLY COMMERCIAL ARC LAMP

FOR

INCANDESCENT CIRCUITS.

Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use 6½, 8 or 10 Amperes of Current.

Please state System and Voltage Used. Address

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We Guarantee Them Electrically and Mechanically.

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FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS.
CURRENT 1 TO 15 AMPERES.

THE ONLY BATTERY SOLD SEMI-CHARGED.

DOES NOT WORK UNTIL WANTED.

ONLY A SMALL QUANTITY OF PURE WATER NECESSARY TO CHARGE IT.

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RECUPERATES QUICKER AND OFTENER THAN ANY OTHER.

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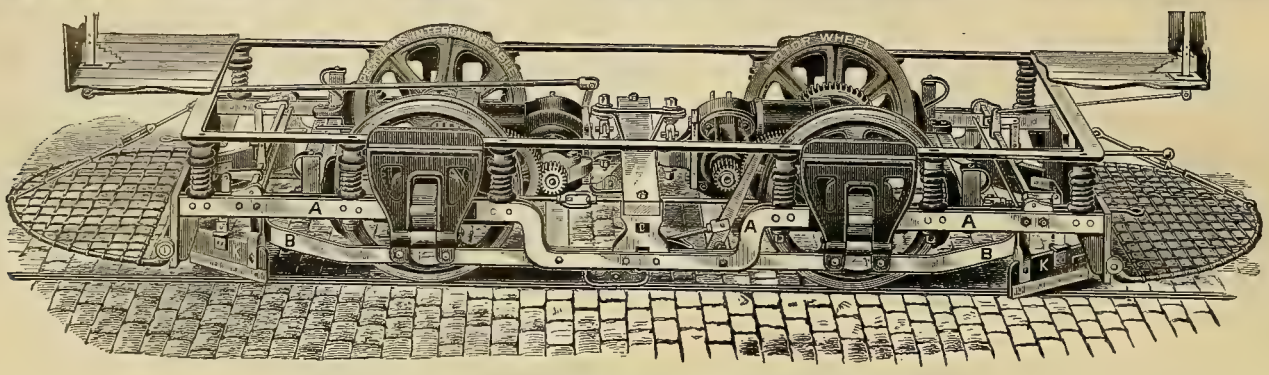

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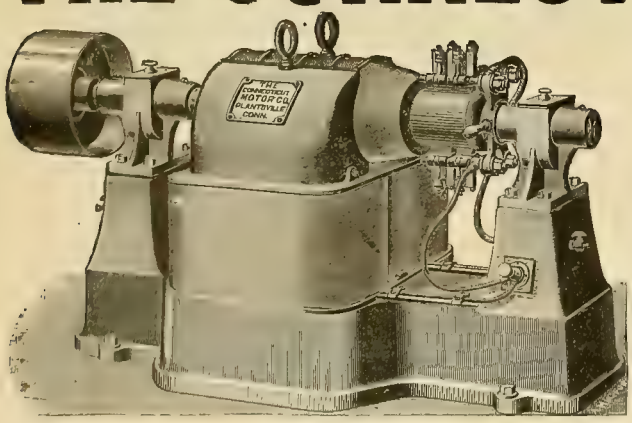

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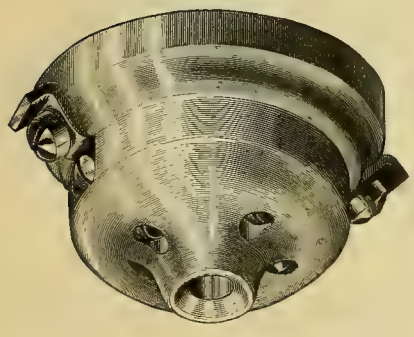

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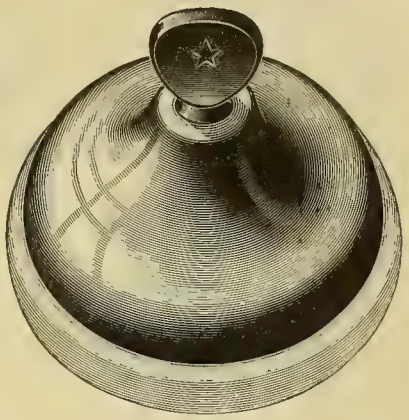

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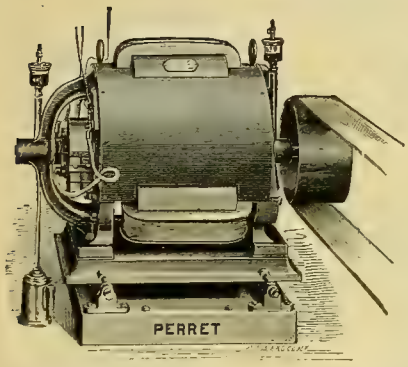

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16 C. P. - - 44 CENTS EACH.

16. C. P. Lamps. 12 Lamps per Belt Horse Power. 600 Hours Average Life.

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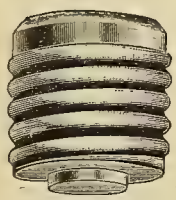
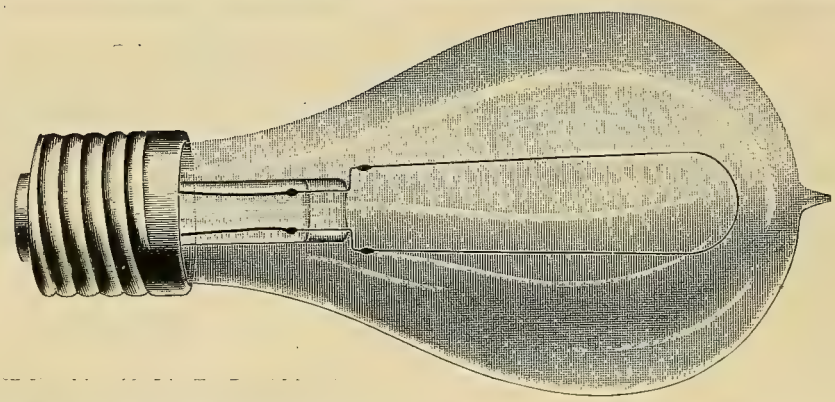
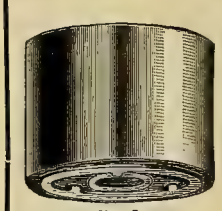
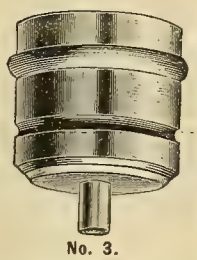


No. 1.
Edison Base.





No. 2.
Thomson-Houston Base.



No. 3.
Westinghouse Base.

No. 4.
United States Base.

Unless otherwise specified, all lamps will be shipped with No. 1 Bases. The other Bases, Nos. 2, 3 and 4, will be placed on lamps, when so ordered, without extra charge.

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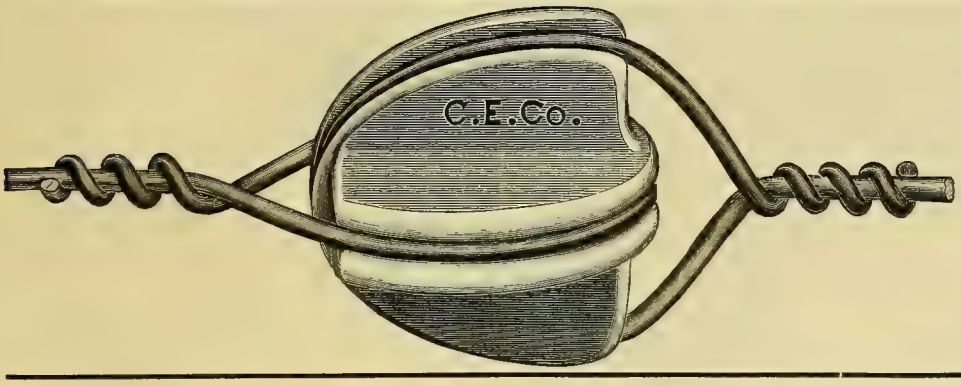

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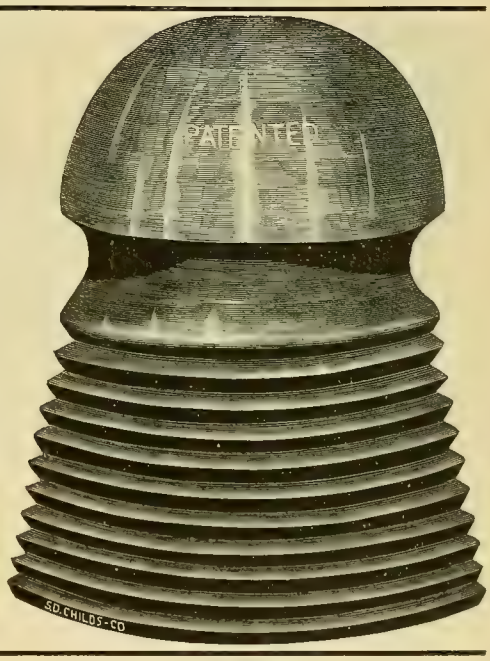
Bain Break Insulator

For Suspending Arc Lamps, Insulating Guy Wires, Insulating Span Wires in Electric Railroad Work, is so simple and perfect in construction as to need no explanation.

THIS NEW

HIGH RESISTANCE GLASS INSULATOR

Is made of extra heavy glass, and is especially designed for large Electric Railroad Feeder and Primary Electric Light Wires. The glass surface between the Wire and Pin is more than doubled as compared with the ordinary Insulator.



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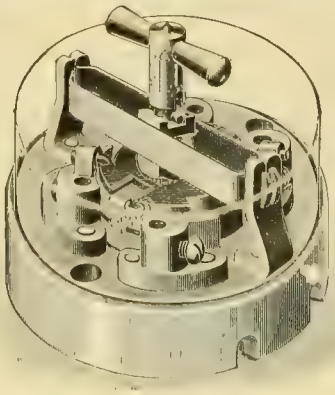

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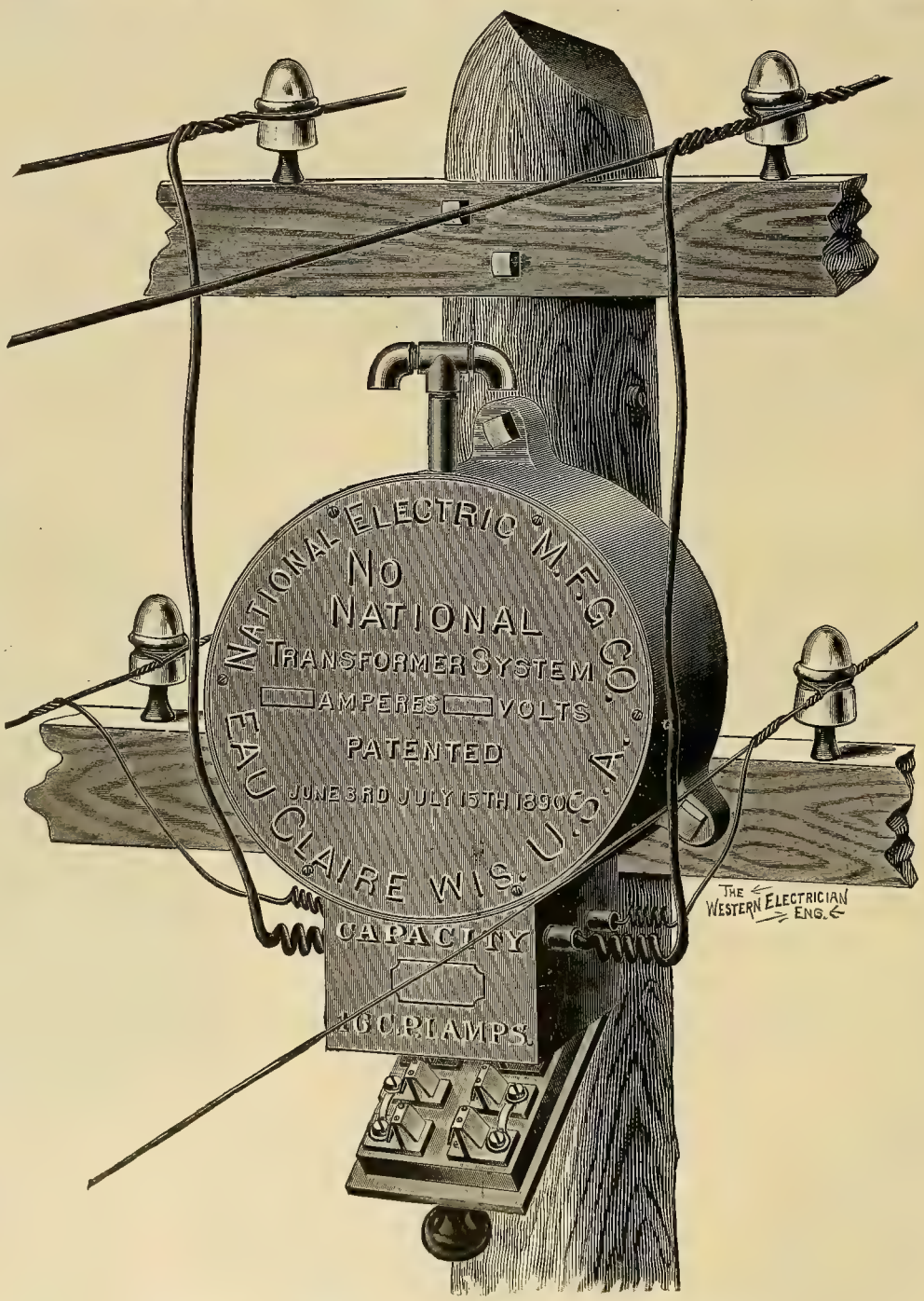
It will PAY YOU to throw out your present transformers and substitute OUR MAKE.

No more Accidents from Grounded Circuits.



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Transformer on Pole Showing National Safety Fuse Box.

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WE GUARANTEE ITS OPERATION AND
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240 Horse Power furnished at a point seven miles from Generator over a circuit of No. O. B. and S. Wire, loss 15 per cent.
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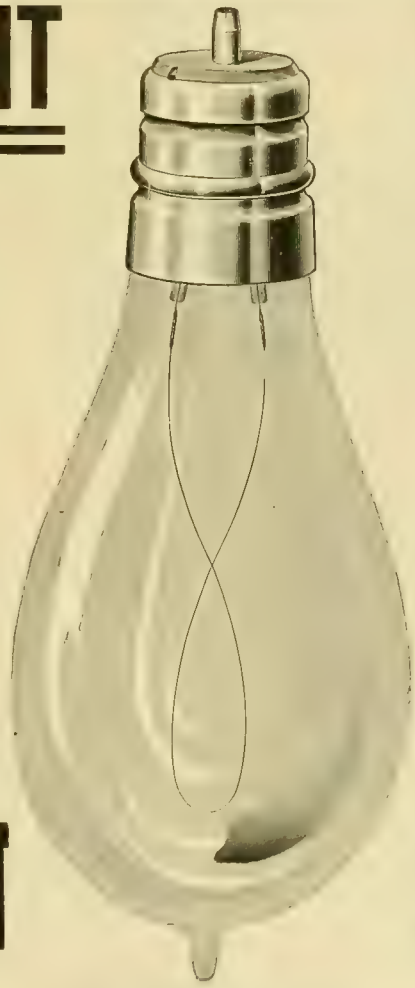

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BETTER than any Dry Battery yet produced.

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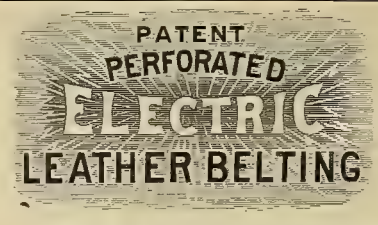

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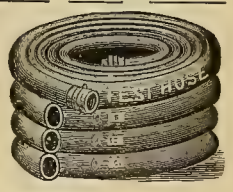
Particularly adapted for Dynamo uses; made of any width or length to order, at a week's notice.



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—FOR—

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THE PAISTE SPECIALTIES,
SWITCHES, CUT-OUTS, SOCKETS,
Are kept in stock and for Sale by all prominent Supply Houses.

Western Electrician.

EVERY SATURDAY.

Vol. VIII. CHICAGO, JANUARY 10, 1891. No. 2

James C. Warner.

Few men actively engaged in electrical enterprises to-day can show a record of service equal to that of James C. Warner of Chicago, whose portrait is herewith presented. Mr. Warner's connection with the development of electrical interests has given him an excellent opportunity to study personally the characteristics of many men who, to day, are historical idols. Mr. Warner's recollection of Morse is particularly interesting as they were associated in a degree in the development of telegraphy.

When Mr. Warner came to this country in 1843 Morse was developing his telegraph project. Mr. Warner has had considerable experience in England in telegraphy. He was born in 1822 in London, and at an early age was engaged with his brother-in-law, F. Kerby, in the manufacture of electrical apparatus. Mr. Kerby had charge of the shop in which were made the Cooke & Wheatstone needle instruments. Mr. Warner was constantly in the shop and was able to keep thoroughly posted on the progress made in telegraphy. When he was 20 years of age a syndicate was formed for the purpose of exploiting electrical projects and development of telegraphy. At that time there was a lull in the electrical business and Mr. Warner decided to accompany his brother-in-law to this country. It was then he met Prof. Morse through Col. Colt. Mr. Warner had an excellent opportunity of studying Morse's character and estimating his ability. Morse consulted Kerby in the development of his scheme and, Mr. Warner says, his conversation indicated that he did not rank highly as a scientist. In fact, he was not well informed on the experiments that had already been made in the development of telegraphy. As an illustration Mr. Warner cites the fact that Morse at that time was having a huge plow made for the purpose of making a trench in which to bury his wires. Before that time experiments had been made in that direction in England, and the plan of burying wires had been abandoned there as impracticable. Then Morse decided to construct a complete metallic circuit, having at that time, evidently no idea of using the earth as a return. Mr. Warner calls attention to many other little features in this connection in support of his position. He says scientists of that day looked upon Morse as a "pirate," and so far as the conception of the idea of practical telegraphy was concerned, few persons looked upon his claims seriously. Undoubtedly Morse's energy and perseverance pushed telegraphy to the front, Mr. Warner says, and there is no question of his ability as a business man. He would be considered a boomer in these days.

During the time Morse was preparing for the opening of his line between Baltimore and Washington, Mr. Kerby and Mr. Warner were engaged by him to make some Cook & Wheatstone apparatus for experimental use upon the system. Messrs. Kerby & Warner had opened a shop on Little Green street, in New York city, and it was there the apparatus was manufactured. The new project of course was the topic of the day, but as soon as it became an accomplished fact, there was a lull in the business for a time and Mr. Warner found employment in other fields. In 1854, however, he removed to Ottawa, Ill., and became engaged in the manufacture of instruments for the Illinois & Mississippi Telegraph company. He continued in the employ of this corporation until it was absorbed by the Western Union company and a new factory established under the superintendency of Robert Henning. Under the new management he continued in the capacity of foreman. The shops were afterward sold to the Western Electric Manufacturing company of Chicago, giving that firm control of the factories in Chicago, Cleveland and Ottawa. This was the foundation of the Western Electric company.

Through all these changes, Mr. Warner was retained and was engaged in perfecting the telegraph system, and when telephony came into prominence he devoted much of his attention to that branch. The drop and spring-jack which bear his name, are the inventions of Mr. Warner. Many other details of the complicated system were worked out by him.

JAMES C. WARNER.

At present Mr. Warner is engaged in the experimental department of the Western Electric company's factory, Chicago. His last active work outside of this was in Melbourne, Australia, where he introduced for the Western Electric company, the first multiple switch-board used in that colony.

Mr. Warner is well preserved, and has an even temperament. He is a man of ability, a reader and close observer, and as he has had unusual opportunities of studying the men engaged in the development of the electrical industry, his mind is a veritable store-house of valuable information. Then, too, he had the advantage of coming from "good stock." His father ranked quite high as an inventor and received several medals from the Adelphi Society of Arts for imitating hand engraving by machinery. His grandfather was also quite prominent as an inventor; he took out twenty patents, among which was the latch key known as the "drop latch" and a small pair of scales to weigh coin, made to inclose in a small box and known as "the Jack in the Box Scales."

His education under such influences naturally tended in the line of invention and improvement.

Indianapolis in Darkness.

On account of the neglect of the common council Indianapolis was in almost total darkness on New Year's night. The business portion of the city has been lighted by electricity, and the contract expired at midnight December 31. The council ordered an advertisement for bids for a new contract in December, but the date was changed to January 5, four days after the time they knew the present contract would expire. It was supposed by the city officials that the Brush company, who had the contract, would continue their lights until other arrangements could be made, and collect the extra cost from the city. Mr. Caven, president of the Brush company, refused to do this, however, and cut off all the lights. Mr. Caven's action, he claims, is based upon the way the city treated him when his contract was made three years ago. He was induced to make a lower bid, he says, than he could afford, by being misinformed in regard to the rates made in the other bids that were received.

Fog and the Telegraph.

The telegraph companies will remember very vividly the last day of 1890. A large part of the telegraph systems throughout the country were idle. Throughout the West, Northwest and Southwest a heavy mist covered the face of the earth, and the wires refused to work. The following message sent by the Associated Press agent at Chicago to the Eastern press tells how serious the weather was:

"The country is hidden in fog and storms Wires worthless and rotten are going from one end of the land to the other. Many of the markets will be abandoned, and only the most startling and important news in briefest form will get through to-night."

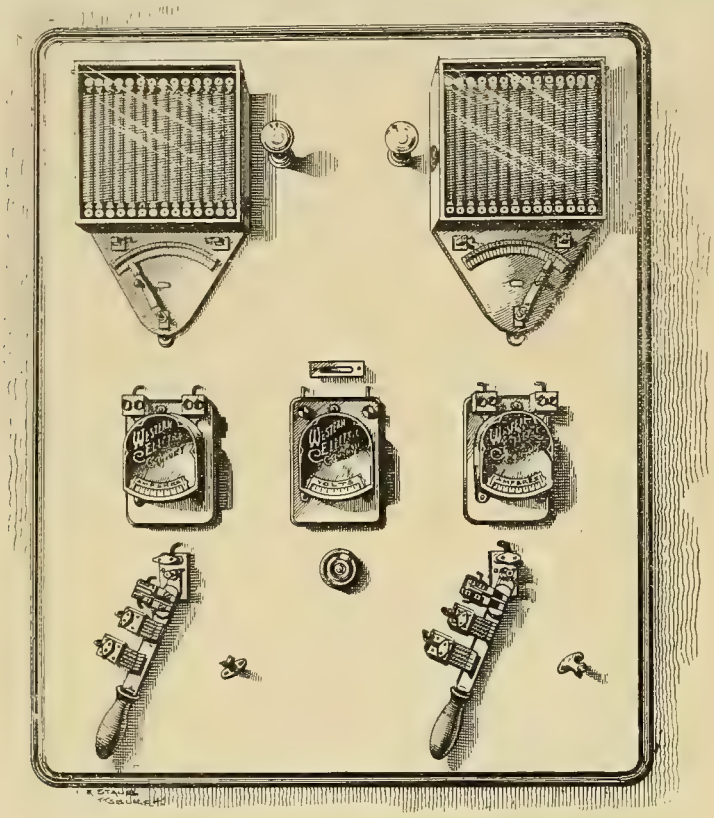
In New York and Chicago scores of operators sat at their tables idle, waiting for a chance click at their keys.

The first sign of trouble was noticeable south of Louisville on December 30. The blanket of fog spread itself finally over a section of country at least 1,500 miles long and 1,000 miles wide. On New Year's eve the situation had grown so desperate that an Associated Press trunk line, usually working in continuous circuit between Washington, Minneapolis and New York, taking in all the important intermediate cities, was cut into short lengths, scarcely a sixth of the usual distance, and extra operators were provided at each sub-terminus. Even then very little business was done.

A dispatch from Richmond, Va., January 3, says: There was filed for record to-day a mortgage from the Richmond Street Railway company to the Union Trust company, St. Louis, and John H. Dougan, banker, of this city, for $200,000, to insure a series of bonds of $1,000 denomination, which are to run thirty years, bearing 6 per cent. interest, payable quarterly. The purpose stated is to make extensions to the electric road, principally owned by Chicago parties, with J. C Shaffer, of Indianapolis, president, and Russell Harrison, son of President Harrison, secretary. It is now one of the most successful electric roads in the country.

Electric Lighting in the Duquesne Theater, Pittsburg.

One of the latest electrical distinctions of which Pittsburg can boast is a theater, which contains, it is asserted, the most complete electric lighting plant of any place of amusement in this country.



ELECTRIC LIGHTING IN THE DUQUESNE THEATER—SWITCH-BOARD.

This plant has been installed in the lately erected Duquesne Theater, which was opened December 1. The building is owned and controlled by Chicago capitalists. While the playhouse itself is comparatively small, the electric lighting plant has a capacity of thirteen hundred incandescent lamps; nearly one thousand of this number are utilized for stage effects alone. Some of the features embodied in the system are unique.

The power plant, which is situated in the rear basement of the building, consists of two compound wound direct current dynamos of 400 lights each; the machines being belted to a Russell engine. The two generators were furnished by the Western Electric company of Chicago, and the steam engine by the Russell Machine company of Massillon, O.

The dynamo switch-board contains two rheostats, two ampere meters, one voltmeter and a ground detector. This switch-board is located in the basement. It is made of polished oak, and presents a very handsome appearance. The dynamos can be operated singly or in multiple.

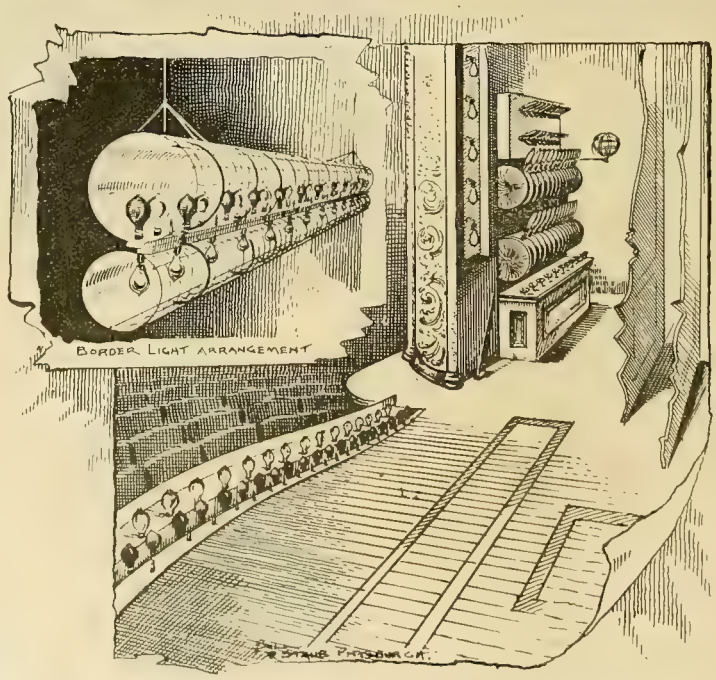
The resistance boxes for the stage auditorium lighting have been arranged immediately beneath the stage flooring. The boxes are made of perforated steel with soapstone tops and German silver resistance. The stage switchboard is very compactly yet conveniently arranged in one corner of the stage, and from it the entire lighting of the theater can be controlled. The board is made of polished oak, and contains twenty-two resistance switches as well as thirty switches controlling the lights in different portions of the house. There are also two main switches on this board, one controlling the stage lights, and the other the lights of the auditorium.

The stage lighting is composed of nearly one thousand lights alone, which are used for different purposes, but not all at the same time. There are one hundred and thirty footlights divided into three rows, one of fifty, and two of forty incandescent lamps. The fifty lamps in the first row have white globes, and the remaining two rows have lamps with red and blue globes. The two rows of colored lights are only used, however, on occasions when their effect upon the stage is required. By an ingenious lever arrangement these lights are pulled up from beneath the floor, and the stage is immediately covered with a shimmer of mingling red and blue. These lights can be made to disappear as quickly by means of the lever. This lever device has been originated by two Chicago electricians, Messrs. Krueger and Leisure. The former is the electrician at the Chicago Opera House and Mr. Leisure, who was a resident of the same city, was induced to go to the Duquesne Theater people, where he is now electrician.

There are one hundred and seventy-five incandescent lamps in the border lights divided into five rows of thirty-five lights each, among which are located red and blue globed lamps to be used as occasion demands.

In addition there are also on the stage, proscenium arches of twenty lights each, ground rows of twenty lights, eight strip lights of twenty lights each, and a number of bunch lights of six lights each. The bunch lights are portable, and can be placed on the stage at points where switches have been placed beneath the flooring.

The main auditorium has four immense electroliers of a very beautiful design containing groups of electric lamps inclosed in opalescent globes. Similar electroliers, only smaller, are suspended in the front of each box. In the balcony are ten fixtures of three lights each. In the rear of the parquet beneath the balcony floor are five fixtures of four lights each. Along the balcony rail is a row of electric "bull's eyes" with frosted globes, while in the foyer of the theater are five small electroliers containing about fifty lights.



ELECTRIC LIGHTING IN THE DUQUESNE THEATRE—STAGE SWITCH-BOARD, FOOTLIGHTS AND BORDER LIGHTS.

Wire-Cutting in Philadelphia.

Wire-cutting has led to legal proceedings in Philadelphia. Two weeks ago Director Stokley and Chief Walker of the electrical bureau of that city sent word to the Electric Power company to remove certain overhead wires. It failed to comply with the order, stating that under the circumstances the removal of the wires would impair its service. A number of men under instructions from the electrical bureau cut several wires belonging to the company.

The company secured an injunction restraining the city from interfering with its circuits. In this bill the complainants explain its system of running wires as follows:

"The wires running out of their building to their customers necessarily cross certain streets; that the company in no place, however, has any poles along the streets, nor does it in any way interfere with the travel upon the streets or with the safety or convenience of the public, etc.; that its wires for private lighting run across and over the house tops in every case with the permission of the owners and occupants."

The company states that it was awarded a contract for lighting a certain section of the city, but had been treated very harshly as it had been refused permission to erect poles in the district although there was no conduit in which it could run its wires. It made an allegation that electric lighting was a necessity, because "the gas furnished by the city is worthless."

The contract for the city lighting of the Electric Power company commenced January 1. The plant was in readiness and current

turned on at 5 o'clock. It was found that a number of its wires had just been cut. The company charged the Brush company with doing the cutting. One of the wires which had been severed, although dead, caused considerable trouble at the corner of Ninth and Market streets. First it became tangled in a mail wagon and ripped the roof off. Part of the damaged vehicle struck a plate glass window and broke it. Then the wire caught on cable cars and tore off parts of the roofs. Before the night was over most of the lights were in working order, and the city was by no means in darkness, as dispatches in the papers asserted.

On the following evening the Electric Power company's employes patrolled the streets in which the company's wires were strung. The circuits remained intact, and the streets were lighted.

A. J. DeCamp, manager of the Brush company, when told that his company had been accused of cutting wires, said: "It has always been the policy of the Brush company, both in this city and elsewhere, not to allow other companies to string wires on their poles. Whenever this is done the orders of the company are to cut the wires, whether they be telephone, telegraph or electric light wires. This has been the custom of our company, and I do not think that they will change it." Further than this General Manager DeCamp declined to discuss the matter.

President Esler of the Electric Power company, made the following statement: "We erected 143 poles and had a permit for every one from the Electrical Bureau, signed by Chief Walker, whose men were present when the wires were put up, and examined them carefully. None of our wires were strung on either the poles of the Western Union company or on those of the Brush company and none of our wires were cut by the former company. After the wire at Ninth and Market streets was cut, Chief Walker ordered it up again and sent his own men to see that it was put up. We, however, strung it so that it did not touch the pole and we are now waiting to see anybody cut it."

Electric Light Plant on the Teutonic.

In the accompanying cuts is illustrated one of the dynamo rooms on the White Star Line Steamer Teutonic, which in August last made the fastest time on record in crossing the Atlantic, five days, nineteen hours and five minutes. The ship is 582 feet long, and 57 feet 6 inches in width. Its indicated horse power is 17,000, and its gross tonnage is 10,000. The ship is built of Siemens Martin steel, and propelled by two independent sets of triple-expansion engines driving twin propellers, with manganese bronze blades. In addition to being minutely subdivided by athwartship bulkheads, the ship is constructed with a longitudinal bulkhead running fore and aft throughout the greater portion of its length, which gives additional rigidity to its structure, and greatly increases the security in the event of accident. The Teutonic can carry 855 fore cabin passengers, 175 second-class, and 300 in the saloon. When fully loaded the steamer will have on board about 3,000 tons of coal, and nearly 4,000 tons of cargo. In the engine and boiler-rooms the ship carries twenty-five engineers. There are sixty firemen, and forty-eight coal trimmers; electricians, ice machine men, etc., bring up the total engine-room staff to 168. It carries a crew of about forty sailors, twenty-five cooks and sixty stewards. Thus, when the vessel goes to sea it may have on board, with passengers, all told, about 1,600 souls.

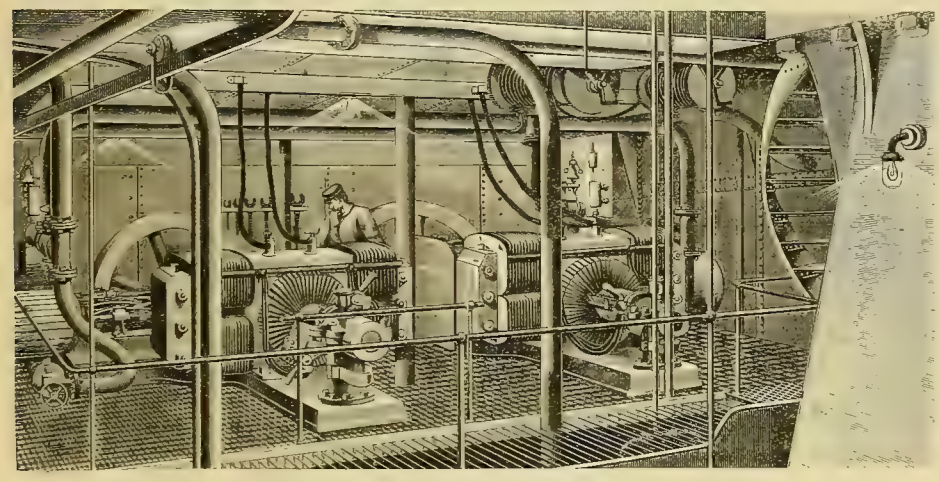


FIG. 1. ELECTRIC LIGHT PLANT ON THE TEUTONIC.

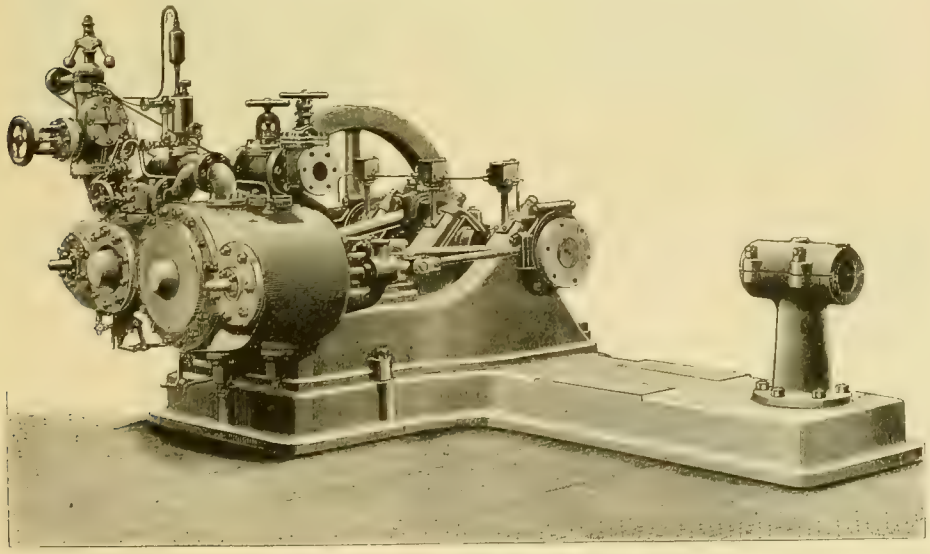


FIG. 2. ELECTRIC LIGHT PLANT ON THE TEUTONIC.

There are two dynamo rooms on the steamer; that shown in the cut is on the starboard side. All the electrical work was executed by the Liverpool Electric Supply company, limited. In each generator room are located two Crompton compound wound dynamos which are driven direct by Tangye engines shown in Fig. 2. Each dynamo is of about 400 16-candle power lamps' capacity. The lamps are divided into eleven circuits. In the saloons and state rooms the incandescent lamps are mounted in gilt and silvered foliated holders of simple and effective design, and form part of the decoration of the ceilings. In the passages and elsewhere the lamps are mounted on substantial brackets and pendants, and are protected with globes and well glasses.

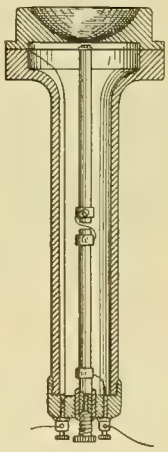
In the stoke-holds strong portable lanterns are used with flexible conducting cables. Special distributing cut-outs are provided.

Four cargo lanterns with strong copper reflectors, and each containing ten 50-candle power lamps, are arranged for use at each hatchway.

The electric lighting engines, Fig. 2, of which there are four—two in each dynamo room—have cylinders 8-inch and 16-inch diameter, 10-inch stroke, arranged to work with steam of 180 lbs. pressure, and to run at 200 revolutions per minute. The rather crowded appearance of the fittings on the top of the cylinders is caused by the special steam pipe arrangements, whereby steam of 80-lbs. pressure from the donkey boiler may be admitted to both high-pressure and low-pressure cylinders, that they may work as two simple engines when the main boilers are not in use. Full power can thus be obtained from the engines when the ship is in dock. The slide valves are of the piston type, the small fittings and oiling arrangements have all been thoroughly worked out, and compared with their size these engines are probably the most substantial ever put into a ship for electric lighting purposes. The cuts are reproduced from the London *Engineer*.

Bergmann Magnetic Telephone.

The inventor of the telephone illustrated in the cut, Sigmund Bergmann of New York,



BERGMANN MAGNETIC TELEPHONE.

claims to have discovered that by passing a current of electricity axially through a magnet its attractive force is varied, and that this variation is sufficient, when the parts are properly arranged, to permit the application of the principle to a telephone receiver.

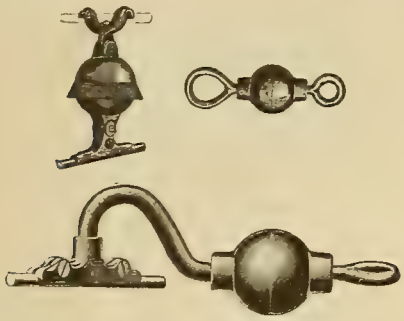
Mr. Bergmann's heory on the action taking place in his instrument is that the molecules of the magnet tend to set themselves at right angles to the flowing current, and that this results in a diminution of the magnetism in proportion to the strength of the current, and hence the magnetism varies in accordance with the current passing through the magnet.

Referring to the illustration the general design of the instrument will be readily understood. The best results, Mr. Bergmann states, have been obtained by arranging two or more magnets in series, as shown, with their ends in close proximity and connected by flexible conductors.

In the receiver the diaphragm carries one of the magnets and the other is attached to the base of the case so that it may be adjusted by a screw. Where two or more magnets are used it has been found that the best effects are secured if opposite polarities are brought together. It is claimed, however, that the instrument works when the same polarities are in proximity.

New Electric Railway Fixtures.

The accompanying illustrations show new forms of insulators for use on overhead electric street railways. The points of superiority claimed, are the use of a trolley wire clamp on the straight line and curve insulators, which does away entirely with the use of solder, yet does not completely cover the wire, so as to cause sparking. This point can be readily appreciated, particularly by men who have had experi-



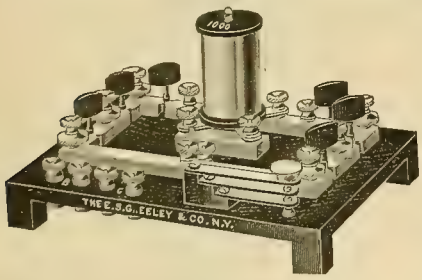
NEW ELECTRIC RAILWAY FIXTURES.

ence in the erection of an overhead line in cold weather. These insulators can be attached in two or three minutes without difficulty. The insulating material in the fixtures is concealed in the cast iron body, and, as will be seen, the construction is such that they shed water readily.

The Electric Construction & Repair company, Chicago, is handling these fixtures.

Frey Electrical Balance or Reversible Bridge.

The electrical balance or reversible bridge shown in the cut was designed by Charles P. Frey, electrician of the E. S. Greeley laboratory. It is intended for measuring rapidly and with



FREY ELECTRICAL BALANCE OR REVERSIBLE BRIDGE.

precision high or low resistances. It is adapted for use in connection with an adjustable resistance box or a B. A. pattern standard coil, and takes the place of the bridge coils which form part of the rheostat of the conventional type. Its peculiar feature consists in the fact that its bridge coils can be tested by reversing or interchanging them, an operation which can be speedily performed. Should any inequality exist it can be quickly corrected. Both bridge coils are shunt wound upon one spool and can be removed to give place to others of higher or lower resistance. A wire bridge with subdivided half-meter scale can be attached. The device is placed on the market by the E. S. Greeley & Company, New York.

Lamp Socket Hook.

In locating the new socket hook shown in the cut the eye screws are set wherever it may

LAMP SOCKET HOOK.

be desirable to hang a drop lamp temporarily. When not burning the lamp hangs vertically from the large hook. When in use the lamp should be projected horizontally by means of the small hook. The hooks are in burnished brass. The lamp hook is manufactured by the Electrical Supply company of Chicago.

S. A. Barton, President of the Brush Electric Company.

The electrical fraternity of Chicago, and especially the members of the Chicago Electric Club, will be glad to know that S. A. Barton has determined to move westward. Although the former president of the Electric Club will not locate in Chicago, he will be considerably nearer the city than at present. On January 1 Mr. Barton resigned from the directory of the Thomson-Houston company of which corporation he was the organizer. Mr. Barton has been a member of the board since 1882. From 1882 to 1886 Mr. Barton occupied the position of general manager and treasurer. He then removed to Chicago to build up a Western business. On returning to Boston in the winter of 1889 he organized a central purchasing department for the various Thomson-Houston interests. His resignation was due to the fact that he had accepted the presidency of the Brush Electric company of Cleveland, O.

Faure Electricity Meter.

The instrument shown in the cuts belongs to that class of meters in which the current is measured by the rotation of a part of the apparatus. The construction of this "motor meter," which is the invention of Camille A. Faure of New York, is based upon the well-known principle that a conductor conveying a current tends to rotate when in a magnetic field.

Fig. 1 is a section of the meter. Fig. 2 is a view showing registering mechanism driven by the moving part of the meter, and also the method of regulating the moving part.

Referring to Fig. 1, *A* is the casing of wood or ebonite. Within the case is arranged a soft

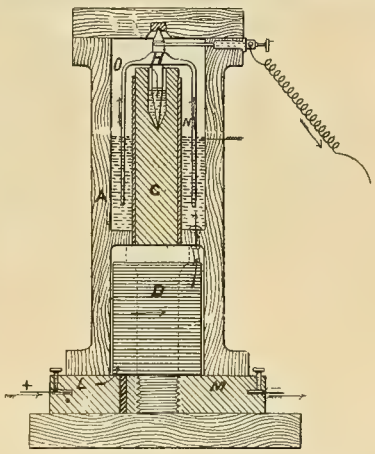


FIG. 1. FAURE ELECTRICITY METER.

iron core *C*. The base of this core is surrounded by a coil *D* through which passes the current to be measured. Above the coil the interior of the case is divided by a partition through which the core *C* extends upwardly. The upper part of the core *C* within the chamber *O* is covered with insulating and impermeable material, as shown, and its top is hollowed out to receive a pivot *H*, carrying two radially-projecting conductors *N*, of platinum or iron wire. These conductor arms are turned down parallel with the core *C* and dip into a body of mercury surrounding the core and insulated from it by the covering of non-conducting material. Mercury is placed in the hollow in the top of the core to insure a good electrical contact, and the quantity of mercury in the vessel is such that when the instrument is laid upon its side the mercury enters the hollow and by this means it is always kept properly charged. An air-tight cover closes the top of the casing and protects the surface of the mercury from the atmosphere. The course of the current to be measured is indicated by the arrows. It enters the iron piece *L*, passes thence through the coil of the core *C*, then to the mercury and rotating conductors *N*, through the core *C*, and out of the base-plate *M*. The passage of the current through the conductors *N* within the magnetic field, causes their rotation, and the spindle *H*, with which they are connected, actuates the registering mechanism.

In the instrument shown in Fig. 1 the current to be measured is caused to circulate in the coils of the magnet and in the moving conductors, and the moving force is proportional to the square of the current. The resisting medium is mercury in the cup. As the force required to move an object through a liquid is proportional to the square of the speed, it follows that the number of rotations of the conductor will be proportional to the current to be measured. The mercury-cup is shown as enveloping the whole of the top part of the magnet and is her-

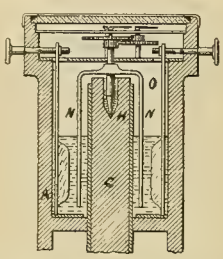


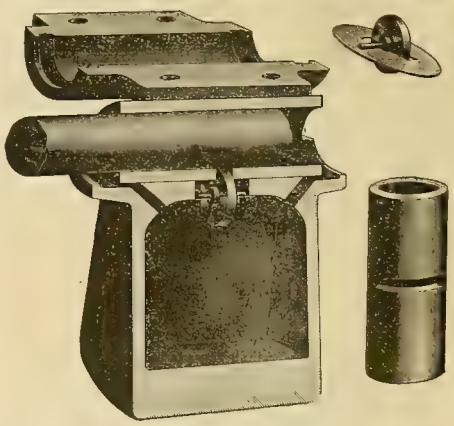
FIG. 2. FAURE ELECTRICITY METER.

metically sealed, so that the mercury may not escape during the carriage of the instrument.

Increased resistance to the motion of the rotating conductor may be applied by means of resisting-vanes, which may be operated from the outside, Fig. 2. In this manner the instruments may be made use of with varying strengths of currents. Mr. Faure, it may be mentioned, claims to be the first to employ a rotary non-commutator electric motor to actuate the registering mechanism of a meter.

Self-Oiling Bearing.

The self-oiling bearing shown in the cut is that which the Card Electric Motor & Dynamo



SELF-OILING BEARING.

company of Cincinnati, O., is using on all motors and dynamos of its manufacture. A glance at the illustration will show the construction of the device. As the shaft revolves a small wheel, held in place by a brass spring, revolves in the opposite direction, bringing the oil from the tank below to the shaft above. The oil passes along the shaft, and through grooves returns to the tank below. The sleeve used in this bearing is easily interchangeable, and the entire construction is simple. These bearings have been in use, it is stated, for three or four years, and in every case are giving satisfaction.

Explosion in an Electric Light Station.

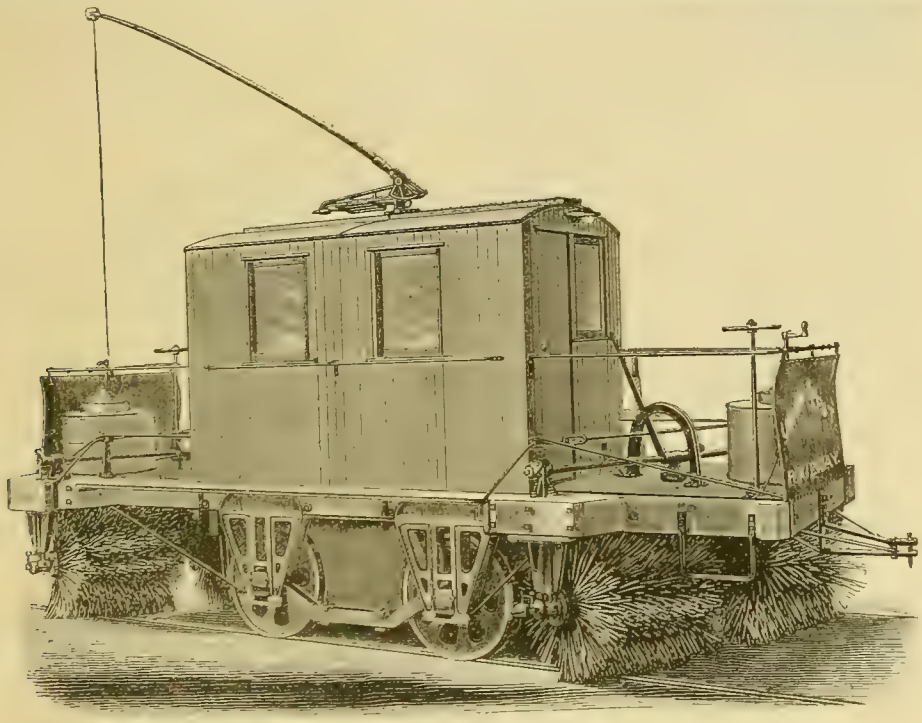
A dispatch stating that a terrible explosion had occurred December 30, in the station of the Louisiana Electric Light & Power company, New Orleans, and that ten men had been killed appeared in the papers last week. It is true that an explosion occurred, but the disaster was by no means as terrible as reported. On Tuesday afternoon the main steam pipe in the station burst, and a workman, Andrew Sharp, was so badly scalded that death resulted. The officers of the company were unable to explain the bursting of the pipes, as all the piping had been recently inspected and had been found in excellent condition.

The city council of Grand Rapids, Mich., is considering a proposition that the city run its own electric light plant.

Electric Snow Sweeper.

The accompanying cut illustrates a snow sweeper constructed for use in St. Louis. The frame and cab were built by the St. Louis Car company and the motors are of the Thomson-Houston type. The sweeper is propelled by two 15-horse power motors controlled in the same manner as on ordinary cars, with the exception that two rheostats are used, one at each end of the car. Cable connections, controller stands, etc., are thus dispensed with and the added advantage is gained that when one rheostat becomes heated, as under the working conditions of the snow sweeper it is quite likely to do, the other one may be used, thus giving the first a chance to get cool. The brushes are driven independently by a single 10-horse power motor controlled in the ordinary way with one rheostat. All controlling apparatus for this motor is within the cab. The car is lighted in the same way as the ordinary cars with a three-light cluster in the cab and a single light at each end outside.

The sweeper can be used either end foremost, the forward brush doing the work and the rear brush being thrown out of gear, and as the brushes are driven independently from the truck, it will be seen that it adapts itself to either heavy or light snow, as in the case of a heavy snow the truck can remain practically stationary while the broom is revolving at its normal rate.



ELECTRIC SNOW SWEEPER.

Alleged Scheme to Swindle Telegraph Operators.

A telegraph operator named A. E. Smith was arrested in St. Louis last week in order that an investigation might be made of the scheme which he has been advertising, that of establishing a telegraph line to rival the Western Union. A few days ago the St. Louis police department was informed by some one, whose name they will not reveal, that Smith was sending broadcast a printed circular soliciting co-operation of telegraph operators in every city in the country in disposing of $1,000,000 worth of stock, at $100 a share, for a new company to be known as America's Rapid Transit Telegraph company. The circular, which also answers the purpose of a prospectus, is very nicely gotten up and is full of good advice to the operators, and goes on to show the large amount of profit there is in the business, and the advantages of owning lines of their own. Smith's name was signed as the general manager, with box 661 as his address at the postoffice, at which place he was arrested while calling for his mail. As he had not victimized any one he was released, upon the promise that he would cease sending the circulars through the country.

Smith recently worked for the Iron Mountain railroad at Piedmont, Mo., as a telegraph operator, and is a member of Division No. 50 of the telegraphers' union, East St. Louis.

Telephone-Electric Railway Decision.

The Superior Court of Cincinnati has recently handed down a decision affirming the decision of Judge Taft in favor of the plaintiff in the case of the City & Suburban Telegraph company against the Cincinnati Inclined Plane Railway company. This was a suit brought by the plaintiff, which controls the Cincinnati telephone service, to restrain the defendant from using the single trolley system. Judge Taft issued the injunction, whereupon the defendant appealed. Two judges concur in affirming the decision. Judge Hunt wrote a dissenting opinion, in which he gave these reasons for believing that the decision of the lower court should be reversed:

I. That the plaintiff in error is in the lawful use and occupancy of the highways under a grant which is in furtherance of the purposes for which the highways were acquired and dedicated.

II. That the plaintiff in error is making use of the grant in a manner contemplated by the statute itself, and by the municipal or local authorities in control of the highways, and that such occupation and use can not be considered as a nuisance.

III. That the record does not disclose that the plaintiff in error, in the exercise of such grant, has unnecessarily invaded or disregarded any of the legal rights of the defendant in error.

IV. That the damages of which the defendant in error complains are not the direct consequence of construction of the electric street railway under the electro-motor system in use at the filing of the bill, but are damages incidental to the lawful operation of the road, and are, therefore, *damnum sine injuria*.

V. Because it is the duty of the state to provide, either itself or through such agencies as it may select, public highways for public convenience, and that it is against public policy to grant privileges or franchises which interfere with a legal and recognized public use of such public highways.

Pumpelly Storage Battery & Electric Motor Company in Trouble.

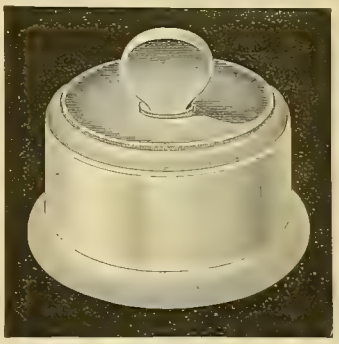
The offices in the Grand Pacific Hotel, Chicago, and factory of the Pumpelly Storage Battery & Electric Motor company have been closed by the sheriff. Two judgments, one for $12,179 and another for $5,000 for money loaned, were obtained last week against the company by Jacob Brown of Detroit, Mich.

Manager E. H. Hill was seen, and he stated that his company hoped to satisfy its creditor and continue the business.

A franchise for another electric street railway has been granted at Dallas, Tex., the line to be about four miles long.

China Switches.

The switch shown in the cut was designed for use in residences where handsome appearance is a great desideratum. The handle, cover and base are made of English ivory china. Switches of this type are made in all colors, to match wall-paper and felts. One noticeable feature is that the cap screws on the base with a thread cut in the china. It is claimed that the switches will always present a fine appearance, as the china cover will not tarnish when exposed to atmospheric changes. They are introduced by H. T. Paiste of Philadelphia.



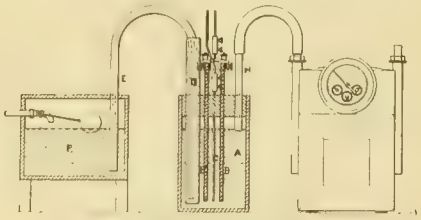
CHINA SWITCH.

Elieson's Electricity Meter.

In one class of electric meters the current to be measured is caused to electrolyze a body of water or other liquid, and the gas evolved is taken as an indication of the quantity of current passing. The meter illustrated diagrammatically in the cut, was designed to operate on this principle.

Referring to the illustration the construction will be readily comprehended: *A* is a closed vessel containing the acidulated water which is to be decomposed. *B* and *C* are electrodes placed in the vessel and connected with the main conductors carrying the current to be measured. *D* is a tube open at both ends and inserted through the cover of the vessel *A*. The lower end of this tube extends near to the bottom of the vessel *A*, while the upper end of the tube reaches, as shown, some distance above the top of the vessel. *E* is a siphon which serves to maintain the level of the liquid in the closed vessel at its normal height. *F* is a supply tank kept filled by the action of a trap. *H* is a tube communicating with any suitable gas meter.

By the arrangement described, it will be obvious that as the current flows through the liquid in the vessel *A*, a portion of the liquid, depending upon the quantity of the current, will be decomposed. The gas liberated collects in the upper part of the vessel until the bottom of the tube *H* becomes exposed. The collected gas now escapes into the meter under the pressure of the column of liquid in the tube *D* and the liquid in *A* resuming its normal level, again closes tube *H*. This action is repeated again and again, the quantity of gas generated indicating the quantity of current passed through vessel *A*.



ELIESON'S ELECTRICITY METER.

C. P. Elieson of London, England, is the inventor of this meter.

It is stated that nearly all the stock has been taken of the company which proposes to make an underground mining and electrical display for the World's Fair. The project was recently described in the WESTERN ELECTRICIAN. The directory has agreed to permit the mine to be sunk at the foot of Harmon court on the Lake Front, provided the Michigan avenue property-owners consent to the arrangement. The company is ready to begin operations as soon as the Lake Front site question is settled. The work will require two years to complete.

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J. B. O'HARA, - - - - - - - - - - } Associate Editors.
F. L. PERRY, - - - - - - - - - - } Associate Editors.
A. C. DURBOROW, JR., - - - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE underground electric railway in London is now in regular operation. An account of the first regular passenger trips is presented elsewhere in this issue. An English electrical journal states that the road will soon become one of the wonders of the metropolis. The successful operation of the line has apparently resulted in the planning of similar enterprises in this country. Underground electric railways are talked of in New York and Philadelphia, and we expect to see some of the many schemes for building underground railways in Chicago revived before many months. Philadelphia wants rapid transit badly. One of the local papers in a new year's edition prints a cartoon representing the new year as entering on a rapid transit train, while the old year is departing on an ordinary street car drawn by a snail. In the same paper is described a project for an underground railway. The local papers are inclined to believe that the scheme would not be profitable, but they are kind enough to say that if capitalists wish to experiment with the subterranean system they have no objections to offer.

IT is stated that when Director General Davis of the World's Columbian Exposition returns from his present visit to Washington, he will appoint three more department chiefs. It is reported that among the number will be the chief of the electrical department. We trust this report is true. As we have said heretofore, we think the electrical section which will unquestionably be one of the most important in the exposition, should be organized at once. There now seems to be no doubt that Prof. J. P. Barrett, city electrician, will be appointed chief of the electrical section. No other name is mentioned in connection with the department. The Chicago *Herald* in an article relating to the probable appointments, says: "The appointment of Professor John P. Barrett, of this city, as chief of the department of electricity and electrical appliances, is one of the certainties. Professor Barrett has been indorsed by more than 250 electrical supply manufacturers, as well as by scores of professional men. There are no other candidates for the place. With these departments organized and the foreign bureau at work, Director General Davis expects to have the fair booming in a few weeks."

IN an article presented in another column, the probability of the substitution of the electric motor in place of the steam engine on trunk lines is discussed. The writer refers to a paragraph in a recent article by Prof. Thurston, who assumed that doubling our present speed would lead to electric traction. For this reason, he thinks, we will be obliged to find means to utilize the weights of the cars themselves, for adhesion, and make each car carry its own motor. The writer of the article in this issue takes the stand that, while everything points to electricity as the future motive power on trunk lines, there are nevertheless serious practical difficulties to be encountered in executing the work of substitution. To persuade the modern steam railway man to adopt a system of propulsion which would necessitate the remodeling of one truck on every car would, he thought, be an impossibility, and for this reason one might naturally expect the pioneer train equipment to be an electric locomotive with trail cars. The tenor of the article is against over-enthusiasm. The writer believes in not underrating the qualifications of an antagonist, and on this account he thinks electrical engineers should remember that it is an ideal system—as far as units of power are concerned—that they are seeking to discard.

THE prospects for a good year in electrical work in England appear to be encouraging. A contemporary writes from the other side of the water, that if one-half of the provisional orders, for which notice has been given, are granted in the course of next year, there will be a busy time for the manufacturers of electric appliances. There is scarcely any town of importance upon which somebody does not desire to confer the blessing of electric light, and this will, of course, lead to an increase of employment for the consulting engineers. With reference to the difficulties to be met with in the introduction of the electric light, the same writer adds that the municipal officials have now to make up their minds whether they will undertake to lay down the necessary plant themselves, or whether they will allow a company to take the risk and the profit for the next forty-two years. In regard to laying the conductors, it was stated that the man who undertakes to lay mains in the congested state of underground London, needs to have plenty of resources at his fingers' ends if he is to make much progress, and whatever system he employs he will have to abandon it at times for some other expedient. It is possible too, that London will not have, in proportion to its size, so extensive a network as some American cities, but the assertion was made that London will far excel them in the way in which the work has been done. It is amusing to note in this criticism, dragged in by the heels, so to speak, how inborn is the Britisher's conceit.

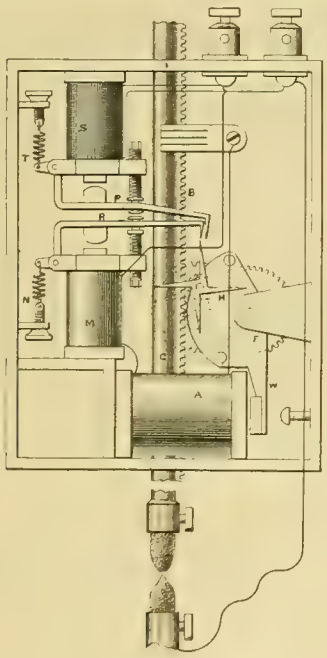
A GOOD electricity meter is now very generally acknowledged to be a necessity by exploiters of electric light and power systems. It is however, a striking fact, that there are few meters which may be said thoroughly to accomplish the purpose for which they were intended. Glancing over the different types of electric meters brought out in this country and abroad, one is struck with their great complexity. In many cases it would seem as though the designers had entirely lost sight of the fact that the instrument intended for commercial purposes, runs but a few hours in the laboratory and spends the rest of its days in, perhaps, a damp or dusty cellar or in some other place entirely unfit to contain machinery of any kind. That it is a problem to produce a thoroughly good meter is not to be denied, but both time and money can be saved by not attempting to exploit a mechanism which in complicacy may be compared not unfavorably to the watch. In this connection, the reader will remember that an electricity meter recently exhibited by one of England's greatest scientists, was described as taking up a space equal to that occupied by an old fashioned clock. As the published drawings of this apparatus appeared to substantiate this comparison, the meter in question may be taken as an illustration of a mechanism theoretically perfect, perhaps, in its action, but nevertheless of little use outside of the lecture room or laboratory.

IT was stated in the last issue of the WESTERN ELECTRICIAN that the city of Philadelphia was seriously considering the advisability of establishing a municipal electric light system, and had even gone so far as to send a committee to Chicago to inspect the city plant. One of the Philadelphia papers has recently declared itself in favor of a city electric lighting system. Its declaration was made in commenting upon a fight among electric light companies of which a statement is presented elsewhere. The award of an electric light contract to a new company this year has led to a multiplication of poles on certain streets, which certainly when present in considerable numbers, do not add to the appearance of a thoroughfare. This state of things has led the paper in question to urge that the city lay at once the foundation for a municipal system. Its suggestion is contained in these words: "The unnecessary multiplication of the unsightly poles used for electric lighting ought to convince every one that the city itself must undertake this business, at least so far as supplying the actual lighting apparatus. A suitable pattern of light iron post should be adopted, and these poles erected at suitable intervals where lights are required, and connected by wires laid in conduits beneath the pavement, as was done on North Broad street years ago. With this secured, the supply of light and power could properly be let out to the best bidder, pending the time when the city shall possess its own electric lighting plant." While the erection of unnecessary poles is beyond a doubt vexatious it hardly seems that such a heroic remedy is necessary as the establishment of a city plant. The removal of superfluous poles ought to be made possible in some way. If all that has been said of the city gas plant in Philadelphia is true one would think that the residents of the city would not incline toward a further application of the principle of municipal control. We have no recent information on this subject beyond that contained in a complaint in an injunction suit instituted against the city by an electric company, but that is rather striking. It alleges that in Philadelphia electric lighting is absolutely necessary, and explains the reason for putting the case so strongly by adding that "the gas furnished by the city is worthless." We trust that Philadelphia will not find that the solution of its illuminating troubles is to be found in any system of city lighting.

Arc Lamp.

The arc lamp shown in the cut was designed by A. W. Whitcomb of Worcester, Mass. The parts may be described as follows: The carbon-rod *C*, has a free vertical movement in the frame and is provided with a rack *B*. At *F* is swung a frame carrying a train of gearing. This train connects, as shown, with the rack so that its movement is controlled by the "flyer" *H*. The lower extension *W* of the train frame carries the armature of the arc-striking magnet *A*. *M* is a magnet connected in series with the arc. *S* is a shunt magnet connected in parallel with the arc. *P* and *R* are two levers acted upon by the magnets *S* and *M*, so as to control flyer *H*.

The operation of the lamp is as follows: In starting the current the magnet *A* attracts the armature on the frame *F*, and the pinion lifts rod *C*, thus striking the arc. This action causes the immediate engagement of one of the teeth of the flyer with hook *R* and prevents any turning of the gears and pinions. As long as the current flows the frame *F* remains stationary, being held by magnet *A*. The spring *N* is adjusted so that if the current is more than normal the lever *R* remains with its hook in engagement with the flyer, and prevents feeding. When the current is normal the spring causes the hook to rise from the flyer and allows the rod *C* to slowly descend by gravity. The spring *T*



ARC LAMP.

is so adjusted that if the arc is too short the hook of lever *P* engages the flyer and prevents feeding.

It is claimed by the inventor that the effect of this mechanism where two or more lamps are connected in series across incandescent mains is to maintain equal arcs. If the shunt-magnet and its brake *P* only were used, the length of the arcs would not be regulated; and if only the main magnet *M* and its brake *R* were used, the sum of the two arcs might be right, but they would not equal each other.

South Chicago Electric Light Station Destroyed by Fire.

The station of the People's Electric Light & Power company at Ninety-fifth street and Erie avenue, South Chicago, was burned on December 31. The loss was estimated to be about $30,000. The insurance was $8,500. The works of the People's Gas company were also slightly damaged. The machinery of the electric lighting plant consisted of three 50-light Thomson-Houston arc dynamos.

The directors of the West End Street Railway of Boston have been authorized to petition the railroad commissioners for leave to increase the capital stock by $4,500 000, divided into 90,000 shares of common stock, to enable the company to pay for construction and increase of property and especially the expense of perfecting the electric system.

Multitubular Accumulator.

Parisian electricians are continually designing new forms of accumulators, for which special advantages are claimed. One of the latest types is that shown in the cuts. The design is that of Donato Tommasi of Paris. It will be

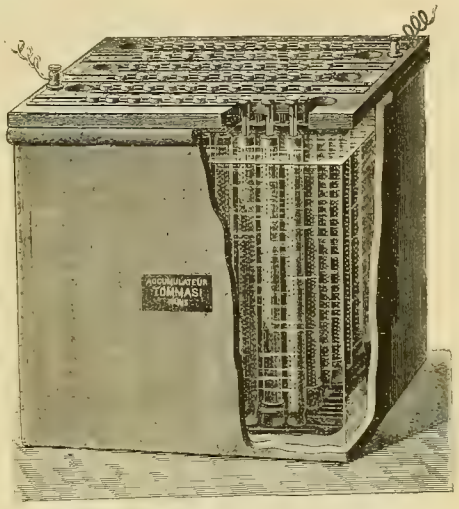


FIG. 1. MULTITUBULAR ACCUMULATOR.

seen in Fig. 1, that the inventor, instead of employing plates in his accumulator, uses a series of perforated tubes. Fig. 2 shows a prismatic form of case which he also uses.

Fig. 1 shows the manner of suspending the tubes. Through the centers of the tubes pass

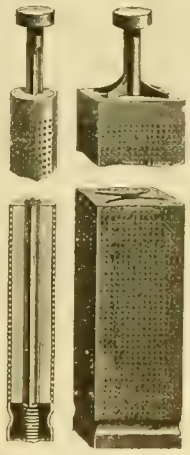


FIG. 2. MULTITUBULAR ACCUMULATOR.

metal rods which end in heads at the top, and which screw into insulated bases of the tubes. The rods may be of different forms, as shown in Fig. 3. The space between the perforated tube and the supporting rod is filled with active material.

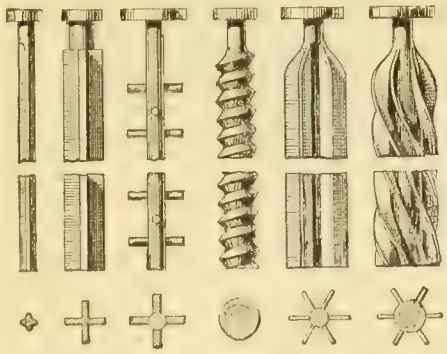


FIG. 3. MULTITUBULAR ACCUMULATOR.

The inventor of the cell claims that many advantages result from the multitubular construction. The current in charging or discharging passes entirely through the active material, he asserts, and heavy currents can be used in charging without dislodging the active material or causing the tubes to buckle. The form of tubes, he claims, makes a greater amount of active material available than in the plate form. He also claims that this form results in long life of accumulators.

Electric Motors on Trunk Lines.

By Pratique.

Prof. R. H. Thurston in the December *Forum* says: "The assumption seems fair that the locomotive engine will have been superseded when we double our speeds, and we must find ways to utilize the weights of the cars themselves for adhesion, and to make each carry its own motor. This evidently points to electric traction."

The probability of the substitution of electricity on the steam railway is an interesting subject for conjecture. We have seen the horse and mule resign to the electric motor their places as factors in a street railway equipment, but when one comes to the consideration of the manner in which a substitution could be effected in the case of the modern steam-driven road, the problem is found to present a different aspect. A number of authorities have attacked the problem. The many "doctors" in this instance do not "disagree," and even the most conservative have had their doubts dispelled on witnessing the wonderful practical results of last year's work in the street railway field. It is permissible, we think, at the present time, therefore, to regard electricity as standing more than an ordinary chance of becoming the future motive power on the trunk lines of the country. Prof. Thurston states that it seems fair to assume that doubling our present speed will lead to the abandonment of the steam locomotive. He adds also that we must utilize the weights of the cars themselves for adhesion, and make each car carry its own motor. Such expressions as these are suggestive, and by seriously considering them the over-enthusiastic advocate of the electric system is brought face to face with the difficulties incident to such a substitution. That difficulties exist is not to be doubted. Railroad engineers deal with facts, and the sanguine electrical man will find, too, that he will not be met half way when he enters the field against the steam horse.

Prof. Thurston's words are suggestive in regard to one condition in the problem. When one stops to consider for a moment the present equipment of a steam road, and also remembers the conservatism of the railroad man, there arises an inclination to doubt whether so radical a departure as the motor-on-the-car equipment will find a place. It must not be forgotten that we have to deal not with the old time horse car upon which a motor can be mounted with comparatively little trouble. How will the wedge be entered in the case of the modern steam railway? Surely, no railway company would consider a new method of propulsion the adoption of which would necessitate the reconstruction of one truck at least on every car, passenger and freight, on the road! It seems reasonable, then, to suppose that we may look for a start to be made with an electric locomotive and not with the motor-on-the-car equipment. In fact, it might not be amiss to remind the reader that an illustration of the tendency toward such practice may even now be found in England. From the present knowledge it would seem fair to assume that the station-along-the-route system supplying the electric locomotive or the storage battery locomotive, will be the pioneer equipment. In this case the fight will probably be between the conductor-along-the-route system and an equipment made up of electric power units. Much has been said for and against the accumulator system. The weight of the cells has been brought up as a point against their use in street car work. Without attempting to discuss the well-worn subject it might not be amiss to hint that this feature, considered as objectionable where power for one car only is required, might be turned to advantage in a storage battery locomotive. Steam locomotives are designed with the view of having great weight on the drivers. The electric motor, as compared with the steam engine, is a lighter machine, and for adhesion's sake alone it would seem as though ballast would be necessary. The weight of the accumulator might thus be turned to good account. These are a few of many points which will present themselves. While expressing our confident belief that electricity will gradually work its way on to the steam road—on elevated roads, perhaps,

at first—we can but state our conviction that it is a mistake to underrate the obstacles which are certain to beset the path of pioneers in this particular field. Let us study the situation as it is, remembering just what it is that we are undertaking to consign to the scrap pile.

The Book Table.

A TREATISE ON ELECTRO-METALLURGY, by Walter G. McMillan. London, Charles Griffin & Co. Chicago, A. C. McClurg & Co. 387 pp. Illustrated, $3.50.

THE ART OF THE ELECTROLYTIC SEPARATION OF METALS, by G. Gore, London Electrician Printing and Publishing Co.

Both of these books were written to meet a demand, and it is a satisfaction to note that the work in each case has been well done. Mr. McMillan's book is the simpler work, and is more general in its scope. The refining of metals by electrolytic means forms only a division of his volume. Dr. Gore's work deals exclusively with separating and refining metals by electrical processes. Mr. McMillan's work aims to give the reader a general idea of electro-metallurgy without presupposing any considerable knowledge of chemical or electrical laws. In his book therefore he has introduced chapters dealing in an elementary way with such laws as he deems essential to a proper comprehension of the subject as he treats it. He devotes a large amount of space to electroplating, and gives a considerable amount of information which will be found of practical value to those working in this field. Mr. McMillan's book may be considered an excellent preliminary book on the general subject, and may be read to advantage by those who contemplate a study of Dr. Gore's work, relating entirely to the electrolytic separation and refining of metals. Readers of the WESTERN ELECTRICIAN doubtless have formed a general idea of the latter volume from extracts which were printed from advance sheets a few weeks ago. It is intended for the use of both students and manufacturers. As a practical book containing a large amount of material, which could be found only by a long and weary search through periodicals, the work will be found of special value. Manufactuers of refined copper may be interested to know that the author says in his preface that he has been permitted to inspect many of the largest plants, and examine their processes and machinery. He says while he does not disclose manufacturers' secrets, that they always leak out, and the idea that any of importance are unknown is erroneous. Dr. Gore's remarks may be true as applying to England, but the idea that secrets of value are not successfully hidden by manufacturers does not obtain in this country. The great majority of copper refiners will tell a different story, we think. We fancy some of the American readers will smile when they notice that the Cowles smelting works are located by Dr. Gore at Longport, near New York. The author in the next edition will doubtless change the name of the city to Lockport, which a map will show him is not a suburb of New York by several hundred miles.

THE ELECTRIC LIGHT, by A. Bromley Holmes, Fifth Edition, London, Bemrose & Sons, 30 illustrations.

This is one of the volumes designed to explain in popular language the general principles of electric lighting. The book is well written, but if an ordinary reader can learn from it the fundamental ideas of electric lighting without considerable persistence and hard study, then our notion of the ability of the average reader is an underestimate. This is saying nothing derogatory to the little book; only we think that the volume scarcely fulfills the promise of the title, "The Electric Light Popularly Explained."

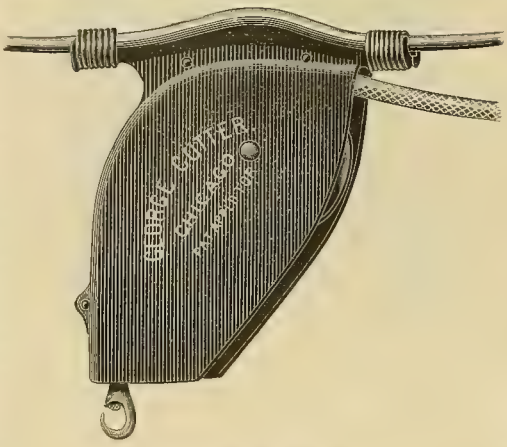
H. E. Haferkorn of Milwaukee has compiled "Handy Lists of Technical Literature," a copy of which has been sent to this office. The pamphlet contains the titles of a large number of pamphlets and books, and the compilation will doubtless be of no little assistance to those who are investigating special subjects.

The Fort Worth Construction company, of Fort Worth, Tex., will erect an electric light plant and ice factory in Comanche, Tex.

Cutter Lamp-Supporting Pulley.

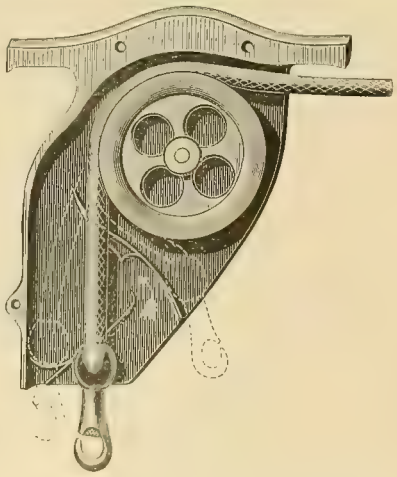
The sleet-proof supporting pulley shown in the cuts holds the lamp when raised, and thus takes the strain off the hoisting rope. The arrangement is such that the mere raising of the lamp by the hoisting rope leaves it supported by the pulley. By pulling on the rope again the lamp is released, and can readily be lowered. The supporting and releasing are effected not by any moving parts, but by the simple arrangement shown in the cut.

On the sides of the pulley are ridges serving as guides for the knob of the hook from which



CUTTER LAMP-SUPPORTING PULLEY.

the lamp is hung. On raising the lamp the knob is guided, as shown by the arrow, up to the curved stop; when the rope is slackened the weight of the lamp pulls the knob down into the recess at the left. The lamp is then supported entirely by the pulley, so that the hoisting rope may be left slack. On pulling at the hoisting rope again and then slackening it, the knob is guided out as shown by dotted lines; the lamp is then released and may be lowered. This arrangement is positive in its action and has no cams or catches to get out of order. Another new feature of the pulley is the method of attaching it to the suspension wire. Binding wires wrapped around the ends of the pulley fasten it to the suspension wire which rests in the grooved upper edge of the pulley. As the cut shows, this puts a kink into the suspension wire and thereby keeps the pulley from slipping. As this pulley combines the advantages of an independent support in a simple pulley, and



CUTTER LAMP SUPPORTING PULLEY.

holds the lamp as securely as a mast-arm, it is claimed it is adapted for use with street lamps everywhere. It is introduced by George Cutter, Chicago.

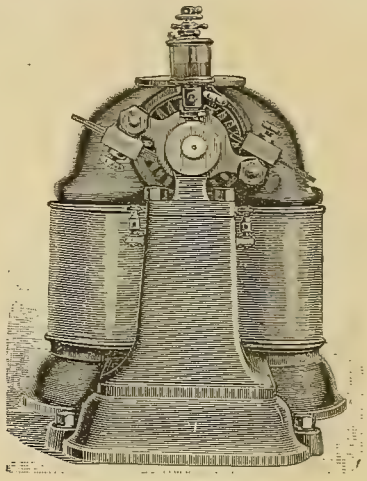
The council at a meeting lately fixed the limit of time within which the Youngstown, O., electric street railway company's road is to be in operation at March 15, 1891.

At a meeting of the Cairo Street Railway company, of Cairo, Ill., lately, one of the important matters considered was the proposition to change the motive power to electricity, under the ordinance recently passed by the city council authorizing the change. They have also increased their capital stock

The Ford-Washburn Dynamo.

The accompanying illustration shows a type of dynamo which is being exploited by Ford & Washburn of Cleveland, O.

A peculiarity of this machine is that the base and bearing-stands are one casting. The field magnet cores are of wrought iron, and the pole



THE FORD-WASHBURN DYNAMO.

pieces are separate castings bolted to the cores. The armature is designed for good ventilation. Air is drawn through the coils and passes out along the shaft and through the openings in the spiders. The armature shaft is of steel. The general design of the motors made by Ford & Washburn is similar to that of their dynamo.

London Underground Electric Railway.

Regular passenger trains on the underground railway in London were run for the first time December 18. The London *Electrical Engineer* has the following to say in regard to the start:

The electric trains of the City & South London Subway started running yesterday morning, the first train leaving Stockwell at half-past seven. The proposed time of starting had been announced previously, and the train was well filled. It performed its first public journey well and in due time, to the satisfaction of every one. Trains were then run continuously on public service at five minutes intervals. A stoppage occurred later in the morning owing to something slightly wrong with one of the engines, but traffic was resumed after an hour's delay, and continued. As the trains have been run for many days with dummy loads everything is now in good working order. The trains are well patronized on the intermediate stations, passengers, whose time of travel on ordinary tramcars took 18 minutes, now getting to London Bridge in 4½ minutes—one quarter the time. The line seems to visitors a little overmanned at present with attendants, but this is far better than the other extreme, and it will be easy to arrange the service with the simplest staff when all is in full and continued work. The enterprise has fairly commenced its career of local usefulness, as well as world-wide stimulation of engineering undertakings in the same field of work, and will rapidly become one of the wonders and sights of London, both to country visitors and to men of engineering ability or financial standing.

The following is taken from the London *Electrician:*

The City & South London Railway was opened yesterday, and a continuous service of trains ran throughout the day. We found a considerable number of passengers at the Monument Station, many of them preferring to use the stairs than the capacious but somewhat leisurely-worked lifts. The line has not been ballasted, as was suggested, the idea being that this would reduce the noise. Conversation is possible, and indeed was carried on between the passengers, but with considerably more effort than on the Metropolitan line. The carriages are lighted with glow lamps, and these, though not very important, are the least satisfactory part of the work. During our visit the dynamos were for some reason excited only by the shunt coils, though the turn of a switch would have compounded them. The result was that every time the train started from a station the illumination fell very considerably, and when one train was standing at a station while another was starting in the adjacent tunnel the same effect was visible. On climbing the steep gradient and severe curve, on the return journey, near the terminus, the lamps were merely red hot. On visiting the engine room at Stockwell, we found two engines at work and one turning round. The needles of the ammeters on the four different feeders were moving slowly between 50 and 100 amperes. The speed of the engines was fairly regular, but the volts, as shown by Sir William Thomson's engine room voltmeters, fluctuated from about 370 to 460.

The city council at Austin, Tex., has granted E. J. Heppenheimer and associates a franchise to construct a street railway, and J. J. and W. H. Tobin have applied to that body for a similar franchise.

Electric Drills.

It is stated that the new railway which is to connect the Argentine Republic with Chili will necessitate the boring of eight tunnels through the Andes mountains of a total length of nearly ten miles. These tunnels, in whose construction water power and electricity are to be largely employed in a novel form, have already been commenced at twenty points. Since August last a cataract of the Juncalillo river, which has a fall of nearly 600 feet, has been made use of to supply the power in carrying out the boring operations in the tunnels of Portillo, La Calavera and La Cumbre. The Portillo tunnel takes a serpentine course through the massive rock, and its upper end emerges at the mountain side, 450 feet above the entrance. The water of the Juncalillo cataract is conveyed through steel pipes half a metre in diameter for the distance of about a half mile to the Juncal station. The boring machines employed in these three tunnels require a force of 1,000 horse power to drive, and this is obtained by converting the water power into electricity. The water, which is carried through the steel pipes, is made to set in motion ten turbines each of 80-horse power, which are connected with the electrical machines. The electricity thus produced is conducted through strong insulated copper cables to Juncalillo and Calavera. From Juncalillo air pressure machines are also supplied in the serpentine tunnel leading up to Portillo. From Calavera four 80-horse power dynamos generate the electricity for the Cumbre tunnel, where six borers, all working at the same time, are driven by eight air pressure engines. On the Argentine side of the mountains another cataract, near Navarro, has been similarly used for driving four turbines, each of 80-horse power. Owing to the distance of the western smaller portion of the Cumbre tunnel water power cannot there be employed and the borings are being carried out by hand. Wherever water and electricity can be used the boring operations are performed, it is estimated, fully four times as rapidly as they would be by hand.

Experiments with Selenium Cells.

At a recent meeting of the London Physical society Shelford Bidwell, F. R. S., showed "Some Experiments with Selenium Cells." The crystalline variety of selenium was, he said, most interesting to physicists owing to its electrical resistance being greatly diminished by light. This property was shown experimentally with different forms of cells, the construction of which was explained. The form recommended was that in which two copper wires are wound near each other round a slip of mica, and the spaces between the wires filled with selenium. The wires form the terminals of the so-called "cell," which before being used, is annealed for several hours at a temperature above 200° C. Many such cells were made in 1880, 1881, and their sensitiveness to light remained unimpaired during 1882. In 1885, however, several were found less sensitive, and others totally useless; only one out of thirteen retained its sensibility till September, 1890. The loss of sensitiveness Mr. Bidwell believes due to an excessive amount of selenide of copper being formed, for although some selenide is essential to the satisfactory working of the cell, too much is fatal to its action. The selenide of one defective cell was electrolyzed, red tufts of amorphous selenium appearing on the anodes. A white substance resembling moist calcium chloride was also present; this he believes to be oxide or hydroxide of selenium. Small polarization currents had been obtained from selenium cells.

A lecture apparatus illustrating the properties of selenium cells was exhibited. It consisted of a cell connected in series with a relay and a battery. The relay was arranged so that it might either ring a bell or light an incandescent lamp. When the bell was joined up, it remained silent as long as the selenium cell was illuminated, but on screening the cell the bell rang. By using various colored glasses as screens, the effect was shown to be due to the red and yellow rays. A similar experiment with the glow lamp was very striking, for, on turning down the gas lamp illuminating the cell, the electric lamp lighted, and was extinguished on turning up the gas. This demonstrated the possibility of an automatic lamp-lighter which would light or put out lamps according as they are required or superfluous. Amongst the other practical applications suggested were, announcing the accidental extinction of railway signal lamps or ships' lights, and the protection of safes and strong rooms.

Westinghouse Company Statistics.

According to the report of shipments made up to December 31, 1890, the Westinghouse Electric and Manufacturing company shipped 217 alternating current incandescent dynamos of a capacity aggregating 248,150 sixteen candle power lights during that year. This makes a total of 730 such machines, with a total capacity of 720,800 sixteen candle power lamps which have been shipped by the company since the organization in November, 1886.

During the first year, 1886, the apparatus shipped had a capacity of 2,400 sixteen candle power lamps; during 1887 they were 106,200 lights; during 1888, 119,950; during 1889, 228,150, and during last year 248,850 incandescent lights.

During last year the company added another branch to its business, the manufacture of electric street railroad apparatus. The company did not commence to ship motors until the first of July. Since then 211 15 horse power motors have left the shop for the equipment of forty electric railways. This makes an average shipment of over 35 motors per month.

The company also commenced the manufacture of alternating current arc light apparatus during the last year. The first shipment of these machines was made in January, 1890. Since that time the company has shipped 107 arc light dynamos aggregating a capacity of 5,680 2,000 candle power lamps.

The Shallenberger alternating current meter and the converters utilized in connection with the Westinghouse system of alternating current electric lighting, are now well known all over the globe. There are now over 30,000 Shallenberger meters and more than 30,000 converters in use.

During the month of December the company received orders to increase the capacity of seven central station plants, where the Westinghouse alternating current system is already in operation, and, in addition, a number of new contracts were obtained for the installation of incandescent as well as arc light apparatus. Among the latest orders are:

An increase of 750 lights for Olean, N. Y.; 3,000 lights for St. Louis, Mo; 1,500 lights for Keokuk, Ia.; 3,000 lights for Louisville, Ky; 500 for Wilmerding, Pa; 750 for Mansfield, Pa.; 750 for Albion, N. Y.; 750 for Berlin Falls, N. H; 750 lights for Windsor Locks, Conn., and 500 for Whitewater, Wis.

Composite Picture.

The accompanying cut is reproduced from a composite photograph of the heads of departments of the Electrical Supply company, Chicago. In the photographic print were merged the portraits of the following gentlemen: F. S. Terry, manager; Wm. Taylor, assistant manager and electric railway department; Wells Goodhue, electric light and power department; W. R. Pinckard, house goods department; H.

D. Ames, accounting department; Charles Wirt, electric light engineering department; M. M. Wood, electric railway engineering department; G. W. Conover, purchasing department; G. G. Carter, sales department; S. D. Merton, advertising department.

The photographic work was done by Steffens of Chicago. Considerable trouble and delay was experienced in getting the picture into its present shape, in which it forms an interesting study.

Chicago Electric Club.

At the meeting of the Chicago Electric club last Monday evening, N. F. Hodson read a paper on "Practical Electricity." He spoke at length of the importance of electrical industries at the present time, emphasizing the marvelous progress which had been made in the past decade. He presented statistics showing the development of electric systems, especially commenting upon electric railway construction. Incidentally he spoke of the adaptability of the electric motor for elevated roads, and predicted that elevated roads in Chicago would be electrically operated. In conclusion, he emphasized the fact that the inventor of to-day, especially the electrical inventor, was well paid for his services, and he thought he would have in the future still greater opportunities to enrich himself by designing apparatus and processes useful to the world.

The heavy snow in London during the last week has sorely tried the omnibus and tramcar horses, who were slipping about in all directions. It has been prosperous times for the South of London electric railway, which, starting just as the snow came on, has received much of the patronage that otherwise would have gone to the 'buses. The dangerous state of the road, moreover, has induced the bus conductors to put up the prices to sixpence, and the invariable price of twopence at the electric railway turnstile is therefore a still further inducement to the public.

CORRESPONDENCE.

New York Notes.

NEW YORK, Jan. 3.—The remarkable fog which ushered in the new year nearly paralyzed the telegraph service throughout the country An official of the Western Union Telegraph company said that in extent, density and demoralizing effect, nothing like it has ever been known. None of the wires were down but nearly all of them were temporarily idle.

At the meeting of the Board of Electrical Control during the week, Mayor Grant announced that all unauthorized poles and wires would be removed. A list of all the electric wires running over the tops of buildings is being prepared for the board. An application for permission to operate an electric railway by the trolley wire system, was presented by Park Commissioner Hutchins in behalf of the Harlem Bridge, Morrisania & Fordham Railroad company. Corporation Counsel Clark said that there was no legal impediment, and Expert Wheeler said that the system was mechanically safe. The matter was laid over for two weeks. The board granted a permit to Ogden Mills to string a couple of wires from Seventy-second street to his home at 2 East Sixty-ninth street, in order that he may favor his guests with the electric light at his reception Jan. 12.

In the suit in which certain patent rights are questioned between the Brush-Swan Electric Light company and the Brush Electric company, Judge Cove of the United States Circuit Court, made an order permitting the defendant to make any sales of electrical machinery, apparatus and supplies in territories mentioned in previous decree, provided it sets aside a commission of 20 per cent on all moneys received pending the final adjudication. This fund will be paid into the hands of the plaintiff company provided it files a bond of $25,000, otherwise it must be turned over to Commissioner Shields, the register of the court.

Two serious accidents have occurred in Newark since the electric railway has been running. In the beginning of a great enterprise like an electric road, more than ordinary precaution should be taken until the public is educated, and a prejudice is overcome. But accidents in which life is taken are not easily overlooked, and electricity of course receives the blame, the people forgetting that similar accidents have many times occurred with the horse car.

W. H. T.

Minneapolis, Minn.

MINNEAPOLIS, Jan. 3.—The Brush Electric company drew $76,000 from the city treasury of Minneapolis under its contracts for street lighting in 1890. There is likely to be close competition for the new contracts. As outlined in the correspondence heretofore, E. G. Potter, defeated republican candidate for mayor, has been selected by his party for president of the council, of which he is a member. He believes in municipal ownership of a lighting plant; and his influence will undoubtedly be thrown toward this plan when the question comes up for consideration, as it undoubtedly will early in the year. A lively controversy is expected, as the local lighting companies have strong friends in the council who will oppose the establishment of a city plant.

The Eau Claire, (Wis.), Light & Power company has now far recovered from the disastrous fire which destroyed its plant Dec. 1, 1890. It is understood that the improvements in its street car service projected before the conflagration will be undertaken as soon as the weather permits in the spring, and that later in the year the contemplated line between Eau Claire and Chippewa Falls will be constructed. The company has received its new Russell compound condensing engine, 500-horse power, from the manufacturers at Massillon, Ohio, and it is now at work in the power house. The old engine is to be used as a relay for the present and until the growth of their interest, which is anticipated, calls it into permanent use.

The project for the construction of an electric railway in Fargo, North Dakota, and Moorhead, Minnesota, with a connecting line between, is now definitely determined upon and a stock company is in process of formation to undertake the enterprise. Local capitalists are moving in the matter, and E. B. Mears, a prominent Fargo banker, has agreed to furnish all the capital needed under certain stipulations not yet made public. It is understood that the Thomson-Houston company has furnished all estimates and is likely to furnish the electrical equipment necessary. Fargo and Moorhead are situated on opposite sides of the Red River and have a population of possibly 15,000. The only street car line either city has ever had, was a short one running only on Broadway and Front street in the former, and this was abandoned in 1883 after the destruction of its rolling stock by fire. The proposed electric line will not

only pay; it will be a great convenience and accommodation to both towns.

It is now stated that the St. Paul capitalists who undertook to secure a franchise for an electric street railway at Winnipeg, Manitoba, have abandoned the enterprise for the present. A very bitter local antagonism was aroused against them when their proposed franchise was before the Winnipeg city government, and they believe that it is best not to undertake it while this exists. It is doubtful if the matter is ever again revived.

Martin H. Gavin, a liveryman recently injured by a runaway caused by an engine on the old motor line, has settled with the Minneapolis Street Railway company for $1,100. The railway company has paid out in damages almost as much as it has earned on this line, and appreciates, as well as the public at large, the advantages of the change from steam to electricity. N. O. F.

Pittsburg, Pa.

PITTSBURG, Jan. 3.—There was a shortage of cars yesterday on the Pleasant Valley Electric Street Railway line and the Second Avenue Electric Street Railway company. This was caused by the burning out of motor armatures. The motors are unprotected and the sloppy, slushy condition of the streets occasioned by the late snowstorm, saturated the motors and the armatures, which resulted in their burning out. On the Second avenue line only six cars were running out of a total of twenty.

The Pittsburg, Allegheny & Manchester Passenger Railway company and the Pittsburg Union Passenger Railway company filed their answers a few days ago to the equity suit brought against them and the president and directors of the Union line by W. W. Martin, guardian of G. M. Kountz, a minor. The suit was brought to have annulled the lease of the Pittsburg Union Passenger Railway company to the Pittsburg, Allegheny & Manchester company. In the answers all the allegations of impropriety in making the lease are denied. At the meeting of stockholders, it is stated, at which the lease was signed, all the stockholders were present or represented, and the lease was granted unanimously. At the meeting the ten shares of stock in the Union line claimed to be owned by G. M. Kountz, a minor, were voted by William J. Kountz, acting for his son. The lease was properly made and with the authority made by law. The present litigation was instigated by W. J. Kountz, the father of the young man, under whose control he is. The court deferred its decision in the matter until some further date.

The New York & Pennsylvania Telephone company of Erie, has begun action against the Erie Motor company in the court of Common Pleas. The action is for trespass and the damages are laid at $50,000. The telephone people allege that the wires of the motor company have damaged the value of their franchise, and that by induction the telephone service of Erie has been damaged to a great extent They claim that right for damages is attached to priority privileges. The telephone company has expended a large sum of money to correct the interference, but without avail.

The employes of the Allegheny County Electric Light company yesterday presented Superintendent Robert Nasmith a handsome gold watch and chain as a token of their appreciation of his uniform and kindly treatment of all under his direction. He was taken greatly by surprise and when summoned to the office to meet a committee of the workmen, he at first supposed there was trouble of some kind brewing. E. H. H.

Louisville, Ky.

LOUISVILLE, Jan. 1.—In electrical affairs the coming year promises to be an unusually profitable one. The amount of business now counted on doubles or trebles that of three or even, perhaps, two years ago.

The biggest project now on hand is the transformation of nearly all the Consolidated Street Railway lines from mule-power lines into an electric-power system. This work can not possibly be completed until late in the spring, according to the announcement of the managers.

Next in importance is the completion of the new Louisville & Jeffersonville Bridge, which is expected about August 1. Over this structure will run electric cars connecting all points in Jeffersonville with all points in Louisville by means of street car transfers at cheap fares—probably not over ten cents each way.

The project next in importance is the proposed lighting of the streets of this city by electricity. It seems probable now that the plan will be carried into effect at once, as the joint committee on gas and water of the general council met Wednesday and agreed to recommend the ordinance as proposed by Mayor Jacob, with a slight amendment. The ordinance originally provided for a five years' contract. The term is now one year, and the privilege of renewing for four years is reserved. It was also decided to amend the contract by extending the electric lights on Main street from Preston to Wenzel, and to place one light on Stony avenue at the crossing of the L. & N. railroad. It is probable that the ordinance, as amended, will be adopted Friday night by the general council. The Louisville Gas company proposes to furnish the electric lights at $66 per arc lamp, and but 180 lamps are provided for in the contract. An amendment will be incorporated so that an unlimited number of lamps above 180 may be used, if found preferable to gas lamps. It is predicted that, at this rate, the arc lamps will soon almost entirely supplant gas for street lighting.

There seem to be some differences of opinion between Manager H. H. Littell of the Consolidated Street railway lines using single trolley system in this city, and the managers of the double trolley system of some of the Cincinnati lines in regard to the respective merits of the two systems when working in the snow. Mr. Littell is also interested in some of the single trolley lines in Cincinnati. He returned from that city after the Christmas snowstorm, and in an interview in the *Courier Journal* a couple of days ago gave his ideas in popular terms as to the respective merits of the two systems. John Kilgour, president of the Cincinnati double trolley lines, takes issue with Mr. Littell in a dispatch from Cincinnati, in which he says: "It now appears that the statement made the day after the snow that the double trolley cars had been stopped, does not mean that such cars can not run in snow. The stoppage was due to the fact that, at a low point in the line, the cars ran through fourteen inches of water melted from snow. This burned out the motors. A double trolley line on Walnut Hills, and one in South Covington ran without interruption."

In this city the electric cars furnished the best service ever had in a snowstorm, all the cars running on time.

At Lexington, Ky., the snowstorm demoralized the electric lines. The total damage to telephone and electric lines, according to the Lexington *Transcript*, is $15,000. The electric cars are now in running order again, but it will take a couple of months, according to the same authority, to put the telephone exchange in perfect order. Electric railway and telephone wires were down, and in the snow became entangled. Telephones were burnt out by the score. The greatest loss was sustained by the telephone company. While the trouble was on at Lexington Christmas day, a horse was killed in the street by a wire that had came in contact with an electric light wire. J. W. L.

Gordonsville, Va.

GORDONSVILLE, Va., Jan. 3.—There is a magnificent undeveloped water power at Manchester, Va. As it is only three miles from the center of Richmond it can be made very valuable by generating electricity. It is estimated that the cost of generating by steam in Richmond is $37 dollars per horse power, and it can be clearly shown that with this water power a horse power will not cost more than $5.

There will soon be in the two cities about 150 miles of electric railway, including the Petersburg line of 38 miles, and the line to Seven Pines, which will make Richmond not only the pioneer Southern town in electric railways, but the one realizing best the worth of the electric motor. Many motors are now in use, and if the cost of power could be reduced, which can be readily done by the means of this water power, at least 1,000 motors ranging from 5 to 50 horse power could be placed in Richmond and Manchester. This property is controlled by J. S. Fleming of Richmond, who intends to correspond with some parties interested in electric plants with a view to the establishment of a power plant. W.

Council Bluffs, Ia.

COUNCIL BLUFFS, Jan. 1.—When the Nebraska Central railway bridge scheme fell through it began to look as if the Union Pacific and the Omaha and Council Bluffs bridges would control all entrances and egresses to the city from the East. However, later developments show that these bridges are to have a formidable rival in a large bridge which will accommodate railroads, street cars, teams and foot passengers. The East Omaha Land company has formed a company known as the Inter-state Bridge & Railway company, which has in view a large double decked railroad bridge across the Missouri from East Omaha to Council Bluffs. In conjunction with the bridge will be built an electric motor railroad, extending from the center of Council Bluffs to the center of Omaha. Railroad yards will also be built on each end of the bridge, making it a very desirable means for crossing the river, and for handling trains and cars with dispatch. G.

Topeka, Kan.

TOPEKA, Kan., Jan. 1. — Captain James Anthony, chief engineer of the dam to be constructed near Topeka, has arrived in the city. The Excelsior Electric company of New York city has the contract for the electric machinery. It is expected that the dam will be completed by March 1, next. It will be 771 feet in length.

The East and West Side Circle Railway resolution was reported at a recent council meeting from the committee on streets and walks with the recommendation that the street commissioners be ordered to remove the tracks of the East and West Side Circle from Ninth street within five days. The motion to adopt the report was lost. A resolution with the following provisions was adopted: That the East Side and West Side Circle Railroad companies shall be allowed six months from date in which to equip their line of road inside of the city with electric motors; in the meantime they shall not operate their road by the motors now in use; the non-use of and non-operation of the roads shall not be construed to forfeit the charter of the roads; the companies shall be required in thirty days to grade the streets so that the rails will not interfere with traffic. H.

Denver, Colo.

DENVER, Jan. 2.—The estimated cost of lighting the city for the coming year according to the figures submitted by the light inspector was given in the last letter from Denver. His estimate of $130,000 was so much in excess of the present rental ($77,856) as to cause an investigation on the part of certain of the aldermen. The result is a scheme for the erection of an electric light plant to be operated by the city which, it is claimed, will result in a net saving to the city of at least $40,000. Alderman Fleming has been devoting considerable time to the question, and estimates that a plant with a required capacity of four hundred arc lights, with fifty miles of pole line would cost $128,000, while with an additional one hundred and sixty arc lights including forty miles of pole line all equipped, would bring the total cost up to $174,000. Mr. Fleming estimates that it would cost $27,060 a year to run the city plant, the interest on the investment in the plant of $174,000, at 6 per cent. would be $10,440, making a total cost per year of $37,500 for the city to furnish its own light or a net saving from the present rental of $40,356. The scheme has the approval of Mayor Londoner, City Treasurer Place and other officials, and is said to be rapidly approaching a consummation. The city will be asked at the spring election to vote bonds in aid of the project.

Articles of incorporation of the Montclair Electric Light company, with a capital of $20,000, have been filed with the county recorder. The incorporators are H. W. Lawrence, W. F. Reed and W. C. Howe, who have secured the exclusive franchise for street and residence lighting. They have contracted with the town of Montclair, a Denver suburb, for 300 street lights, and will at once enlarge the capacity of their plant from 600 to 1,100 lamps. They employ the National electric system, and their plant will represent an outlay of $40,000.

An electric railway company has been formed at Leadville, the chief promoters being Dr. John Law and Colonel R. G. Goodell, world's fair commissioner and the Cloud City will soon have about six miles of road. Work will be commenced at once, and about $200,000 will be put into the enterprise. Eastern capital is back of the project. C. W. C

Nashville, Tenn.

NASHVILLE, Jan. 2.—The United Electric company has made a contract to build a considerable extension of its lines on the east side of the river. The extension is to begin on the Fatherland street line at Tenth street, thence south along Tenth to Shelby avenue, and thence east along Shelby to and beyond the corporation line. A land syndicate has purchased a large body of land, laid it off in lots, and this new line is to extend through the property. The contracts call for the completion of the work in seventy days from December 1. It is said the street car company is to receive a large bonus from the land company for this extension.

Several circumstances have conspired to prevent the Citizens' Rapid Transit line from operating cars at the time appointed, and its cars are not yet running. Trouble was met with from improperly stringing the wires at one point. The trial trips developed the fact that the power is not sufficient to run as many cars as the line will require. This line passes over Capitol Hill, which has a long, steep grade.

The work of construction still goes steadily on the Nashville Electric Railway & Power company's line; about one-half the track has been completed and the grading is nearly finished.

The strike of the linemen of the Capitol Electric com-

pany reported by the daily papers, did not amount to much. The company desired to reduce its force during the winter months and gave the men an option of laying off a portion of them or accepting $2.50 per day instead of $3 per day. Seven or eight of them preferred to lay off. That is all there was of the strike. There will most likely be some trouble from strikes sooner or later, as every trade in the city, with the single exception of the boiler makers, is now thoroughly organized for the first time in the history of the city.

The Postal Telegraph-Cable company is pushing its lines through to Louisville at the rate of about five miles per day. They appear to have some trouble in securing rights of way in the latter city. They work Chicago and the Eastern cities now by way of Chattanooga, and claim to have all the business they can handle. Their rates are precisely the same as those of the Western Union, and the most amiable relations exist between the two companies.

The city government has in contemplation a bill asking power from the legislature to issue bonds for the erection of gas works. This step is taken, not with a view to the immediate erection of a new gas plant, but simply to protect the city against any combination on the part of the gas and electric light companies, when the present contract expires during the next two years. B.

St. Joseph, Mo.

ST. JOSEPH, Mo., Dec. 25.—Dr. James M. Heddens has been chosen president of the People's Street Railway & Electric Light company and will assume direction of affairs at once. J. G. Schneider has been chosen assistant secretary and assistant treasurer of the same company.

In a few days all the books, papers and effects of the New York office will arrive in St. Joseph and an auditor will be named to take charge of the auditing department. George Gough will probably be chosen. It is thought the company's headquarters will be permanently established in this city by the new year.

John Donivan, Jr., is president of the Union Street Car company, and John H. Van Brunt secretary, and as yet, W. J. Hobson is president of the Wyatt Park line, with Charles Hobson secretary. At this time the three companies are operating separately, but steps have been taken to consolidate the three under one general head, with one set of officers, but to do this some little time will be required. This consolidation may be effected early in the new year.

The Union depot is now reached without change or transfer from King's Park, in the extreme north part of the city, and from the machine shops of the Kansas City, St. Joseph & Council Bluffs road on the south.

The next move in street car service is the laying of the track on Olive street between Sixth and Seventh, connecting the Wyatt Park line with the Union line, thus admitting passengers from that part of the city to the depot without change. When it is completed, and the probable consolidation of all the lines under one management is effected, a one-fare system throughout the city will be established.

There has been filed in the office of the circuit clerk at Columbia, Mo., a petition for an injunction to restrain the board of trustees of Columbia from proceeding with the construction of the combined waterworks and electric light plant. The people, by a four-fifths majority, voted last month in favor of issuing $45,000 in bonds for establishing such a plant and the board under this vote has contracted for a location, ordered bonds issued, and taken other preliminary steps. The case comes up with the State of Missouri and C. H. Gordon, prosecuting attorney of Boone county, as plaintiffs. The petition alleges that under the statutes of Missouri, Columbia has no power to own and operate the proposed plant, and if it had, that there were irregularities in the election which make the issue of bonds illegal. Judge Alexander, in an interview, declares the town has ample power under the statutes to issue the proposed bonds The proceedings may delay the erection of the plant, but the people will eventually get light and water. The Columbia Gas company is popularly supposed to be interested in the fight against these improvements.

The first trial trip of a car of the Metropolitan Electric Railway company at Springfield, Mo., took place recently and proved a perfect success. The first car was occupied by the members of the city council and press The company has completed sixteen miles of track and has one of the best equipped power houses in the country, the whole costing $500,000. R. P. Hobart of St. Louis is president of the company; Frank B. Smith, manager, J. F. G. Bently, treasurer, and B. U. Massey, attorney. Among the leading stockholders are L. M. Rumsey, R. C. Kernes and Geo. W. Parker of St. Louis. The Springfield Railway company has lately contracted for exchange of power to electricity. Altogether Springfield has about twenty-five miles of street railway.

The Carthage & Twin Cities Electric Railway & Power company, of Carthage, Mo., has been incorporated with a capital stock of $150 000 The incorporators are Maj. W. B. Myers, Maj H. H. Harding, C. O. Harrington, Joseph Harrin, G. D. Sleeper, C. N. Reynolds and Albert Cohn. The company is formed to operate a street railway in Carthage and to extend an electric road to Webb City and Cartersville, nine miles southwest, and to furnish electric power to several mines. The Carthage horse railway lines will probably be absorbed and be transformed into an electric line, and three miles more will be added by extensions. The survey to the other towns will be made at once, and the work pushed as weather permits until the lines are completed M.

THE ELECTRIC LIGHT.

It is reported that Crawfordsville, Ind., will buy an electric light plant costing about $25,000

The Lampasas Springs (Tex.) Electric Light & Power company, with a capital stock of $20,000, has been incorporated.

It is reported that A. W. Allison, B. M. Statton, W. H. Bates and others will build an electric light plant at Memphis, Tenn.

Jamaica, L. I, was lighted by electricity last week for the first time. Eight hundred lamps are distributed throughout the village.

The Cleveland board of public works recently adopted a resolution authorizing the clerk to call for bids for electric and gas lighting of the streets.

The Wilmington Electric Light & Power company of Wilmington, Ill., has been incorporated. Capital stock, $21,000; incorporators, Desire J. Courval John Hamilton and Joseph H. Ray.

Washington, Pa., recently awarded a contract for forty-seven arc lights of 2,000-candle power to the Washington Electric Light & Power company at $85 per lamp-year on an all-night schedule.

Wilson, N. C., authorized at a recently held election the issuance of $75,000 of bonds; $60,000 of the proceeds are for the construction of a system of waterworks, and $15,000 for the erection of an electric light plant.

George Adams, William Erskine, D. L. Heiskell and others have incorporated the Glen Dale company, of Glen Dale, W. Va., to mine coal, bore for oil and gas, construct and operate electric light plant, gas works, waterworks, etc

The Electric Light & Power company of Centralia, Ill., has elected officers as follows: T. J. Wilson of St. Louis, president; J. J. Wetmore, vice-president; S. L. Dwight, secretary and treasurer, and James Benson superintendent.

The Idaho Electric Light & Power company has been formed at Wallace, Shoshone county. The directors are Charles W. O'Neill, Frank C. Loring, Fred E Lucas, Charles A. Wing and Ely P. Spaulding. The capital stock is $500,000.

The Kingman Water & Electric Light company, of Kingman, Kan., has been incorporated; capital, $100,000; directors, Frank Vincent, John F. Vincent, Hutchinson; John W. Hood, Clay Center; Robert G. Brodie, Emporia; Vernon C. Jarboe, Kansas City, Mo.

The Burlington, Cedar Rapids & Northern Railway company, it is claimed, was the first in this country to light a train for actual service with a storage battery. Two trains running between Burlington, Iowa, and Albert Lea, Minn., have each had in use for three years past, about thirty lights which have proven very popular with the patrons of the road and very satisfactory to the railway officials. The old batteries on one of the trains having become worn out, an order for a new plant has just been given to the Illinois Anglo American Storage Battery company for thirty-two of the Sorley cells, which are now being built for the purpose, a few changes having been suggested by the railway company's electrician.

A recent issue of the *Bulletin International de l'Electricite* contains a description of the electric lighting of the National Powder Mill of St. Médard-en-Jalle. The directors had erected a small experimental plant at first, in order to test the applicability of the electric light throughout the works. The lighting being found satisfactory, MM. Sautter, Harlé & Cie., were instructed to put up a complete installation, which is now in full operation. There are installed nine arc lamps of 1,500 C. P., and a number of incandescent lamps, which are protected against breakage by glass globes and wire guards Owing to the various buildings being some distance from each other, it was not easy to carry out the lighting arrangements. It was necessary to install glow-lamps in buildings 975 yards from the generating station, and maintain a constant potential of 110 volts at the end of a conductor of 45 mm. square section, while the consumption of current might vary from zero to 120 amperes. These objects have been attained by the employment of an extra compound-wound dynamo having two windings. One of these is in series and the other in shunt, and separately excited at a constant potential by an independent dynamo. The working of this machine has answered the anticipations put forward. When fully loaded, the loss in voltage at the distributing center does not exceed 6 volts, and the independence of the arcs has been obtained. Two relays, one having a green and the other a red lamp, are placed in the engine room, so that any variations in the e.m.f. due to any change in the speed of the exciter may be ascertained. The dynamo, which runs at 800 revolutions, works 18 hours out of the 24 with a variable load.

THE ELECTRIC MOTOR.

The Zanesville, O. electric railway line is nearly ready to go into operation.

The Winona, Minn., street railway is to be equipped for electricity in the spring.

An electric railway company has been formed at Leadville, Colo., for the purpose of constructing a six-mile line.

The Edison Electric company has been awarded the contract for converting the street railway of Raleigh, N. C., into an electric line.

The North Highland Electric Railway company, of Columbus, Ga., has been chartered by the legislature to build an electrical railroad.

In a short time Austin's electric street railway will be in operation in Fort Rouge, and application will be made to extend its line into Winnipeg, Man., next spring.

Athough twelve miles of electric street railway have been laid in Aurora, Ill., a new company has been formed to construct another line to be run by the storage battery system. It is composed of Fay Winslow, John Plain, T. N. Holden and others.

A franchise extending twenty years has been granted to the East St. Louis, Venice and Madison electric street railroad of Venice, Ill., which will pass through Brooklyn, Venice and eastward along the Edwardsville rock road toward Madison, as far as the corporate limits of Venice extend.

A Grand Rapids Mich., paper says: Another rumor has it that the Cable company will abandon the cable system and substitute electricity. As a matter of fact it is doubtless true the managers of the company now see the error they made in adopting the cable at all for a city the size of Grand Rapids.

Two of the Short generators in the new Center street power house of the street railway company of Rochester, N. Y., are now furnishing power for the running of the electric cars on State street and South avenue, and there has been no more trouble with them. Fifteen cars are in use on that line. The power from the Brush electric light works has been dispensed with. The power to run the cars north of Lyell avenue is furnished from the Charlotte house. Before the winter is over the company expects to have its electric system in operation on Sophia street, Lyell avenue, Allen and Jay streets, East Main street, Hudson street and West avenue. The West avenue line is already equipped. Power is practically all that is needed in order to operate many more lines. A turn-table will probably be used at the corner of North avenue and East Main street where passengers will be transferred. Horse cars will be run on North avenue until some arrangement is made with the Bay railway people. The electric road requires two tracks and the Bay railroad has a track of its own north from Bay street. There is not room for three tracks on the street.

In a pamphlet just issued by Siemens & Halske, the following particulars of their electric tramway on the open conduit system now in operation at Budapest, are given: The channel has a uniform breadth of 11.2 inches. The slot giving access to the conductors is placed in the groove of one of the running rails, so that there is no more metal exposed in the roadway than is the case with the horse tramway lines. At intervals of four feet along the channel, iron chairs 7.2 inches broad serve to support the running rail, and also to carry insulators, to which the conductors are attached. The bottom of the channel, which is formed of concrete, is at a depth of 22.8 inches below the surface of the roadway, and the slot between the rails which form its roof is 1.3 inches wide. The conductors, of which there are two (positive and negative), consist of angle iron, and are placed at the sides of the channel so as to be out of sight and out of reach. The cars carry a single motor, geared to one of the axles, and four groups of resistance frames for regulating the speed. The current is supplied at a pressure of 300 volts. Three lines with an aggregate mileage of five and a half miles are at present in operation on the above system. A fourth line is at present building, but on this an overhead conductor is to be used. At the central station there are at present three 100 horse-power compound engines, each driving a dynamo by means of rope belts. A speed of 9⅓ miles per hour is allowed, and at certain parts this may be increased to over 11, whilst at others it has to be reduced to 6 and 3¾. The day's work ranges from 75 to 95 miles per day per car.

The Rochester, N. Y. street railway men have their eye on the New Haven street railways as the following from the *New Haven Register* shows: The notice of an application to the legislature of John N. Beckley and others for power to construct a street railway in New Haven has occasioned some comment. The scheme contemplated is a belt line road around New Haven, with intersecting branch roads running through the principal thoroughfares throughout the city. The promoters of the scheme are outside capitalists and are none other than a Rochester syndicate which has just secured control of the Bridgeport horse railroad, and has made efforts looking to the construction of street railroads in other cities. J. N. Beckley, the gentleman whose name heads the application, is a leading member of the syndicate, and was one of the purchasers of the Bridgeport property. This syndicate, it is understood, is securing horse railroads in all cities where they can get a foothold, and are introducing the rapid transit system in the way of electrical motor cars. Wherever they are unable

ble to purchase a railroad they are taking steps to establish new lines and the present petition is sufficient evidence that the syndicate proposes, if possible, to secure a line in this city. This syndicate proposes to introduce the Short electric motor system in Bridgeport, which is a single wire trolley system. The line proposed affects nearly every line in the city. Inquiries at the various horse car offices revealed the fact that they were ignorant of the gentlemen who were engaged in the proposed scheme. Attorney Simeon E Baldwin said: "I am acting for a syndicate to establish a new street car line in this city. There are several New Haven gentlemen interested whose names I do not care to give at the present time any further than that I am one interested. The majority of the men interested are outside capitalists, and I may say the bulk of the capital will come from outside. Mr. Beckley is the vice-president of the Rochester street railroad, and has an interest, as have also several other of the gentlemen connected with him in the Bridgeport purchase. We propose, if we get a charter, to give the citizens a first-class street railroad which will be operated with electrical motor power and will give the citizens rapid transit."

THE TELEPHONE.

The Chicago Long Distance Telephone company has filed a certificate setting forth an increase of its capital stock from $1,000,000 to $2,000,000.

The Bell Telephone company of Philadelphia, suffered greatly from the storm of last week. It was obliged to issue this circular to its subscribers: "The sleet and ice of last week damaged many of the wires and fixtures of this company, and made climbing so dangerous that it was impossible to make any repairs before the beginning of the present week. We have secured, so far as we can, the help of every competent man, to hurry along the work of repairing breaks and reestablishing connections. We desire to assure you that no effort or expense is being spared on our part to restore the service, and we believe in a very few days that the exchange will be working as usual. A large force of men is at work repairing the lines."

Miscellaneous Notes.

An English paper says: "At the coroner's inquiry into the circumstances attending the recent explosion at Vivian Pit, which resulted in three deaths, Colonel Ford and Mr. Martin, mine inspectors, expressed themselves in favor of firing shots by electricity as safer than fuses."

A curious controversy has been going on in Chicago. An ex-burglar and a detective have been communicating to the press their views on the subject of protecting houses against the depredations of house breakers. The detective says it is hard to guard against the marauders on account of their skill. The ex-cracksman says if proper precautions were taken in guarding windows and entrances the danger would be greatly lessened, and he sneers at the alleged skill of burglars. An architect was called upon for an opinion, and expressed his idea in these terms: "We have something here in America, however, which discounts iron bars for the windows, and that is the electrical burglar alarm. As Lieut. Kipley has said, a burglar can saw through bars or cut out a pane of glass, but with the electrical appliances now being used in many houses, and which are rapidly growing in favor, the slightest movement, almost, of door or window after the alarm has been set will form a connection and set a gong ringing in a far part of the house. The inmates are thus alarmed, while the man gaining a stealthy entrance is not even aware that his movements have aroused any one. By carrying the system further the same connection that alarms the sleeper may convey the alarm to the nearest police station. Screen doors and windows are thus provided with the telltale appliance, so that the least attempt to make a hole will close the electric circuit and let the people know what is going on. I consider the electric alarm the most effective yet invented, and it is only a question of time now until all houses are provided with them."

Personal Mention.

Charles A. Stone of the Massachusetts Electrical Engineering company of Boston was in Chicago last week.

Mrs. Bridget Barrett, mother of City Electrician Barrett, of Chicago, died on Sunday, January 4. Mrs. Barrett was 72 years of age, and leaves two sons and a daughter.

Joseph E. Lockwood of Detroit, was in Chicago this week. Mr. Lockwood, who has been manager of the Brush station in Detroit, has just resigned his position.

Business Mention.

The firm of Partrick & Carter, of Philadelphia, will hereafter be known as the Partrick & Carter company. The company has just removed to 125 South Second street, and 131 Gothic street, where it will have increased facilities.

The Eastern Electric Cable Company, of Boston, is receiving many testimonials in regard to the Clark wire which is proving efficient when tried under the most adverse conditions. The wires used in the Chemical Works, the Kings Continental Brewery, and the cables underneath the New Bedford bridge, wet by sea water at high tide, and remaining in the dry air at low water, have given entire satisfaction.

Since the new proprietors came into possession of the Heisler Electric Light company the work of increasing the output and facilities of the company has been going on uninterruptedly, and the announcement is now made that the system is to be pushed vigorously in all parts of this country and abroad. The Heisler system is well and favorably known, and now that the company is in a position to handle the very largest orders, a large volume of business will undoubtedly result. Live and responsible agents are wanted at once in New York, New Hampshire, Massachusetts, Connecticut, Vermont, the Southern States, Upper and Lower Canada and the Northwest Territory. The company's offices are in the Drexel building, Philadelphia.

The advantage of a dry battery in point of cleanliness and general convenience, has been generally appreciated by battery users, and now the notion that such batteries are not equal to a liquid battery for ordinary work, is rapidly disappearing. The Electrical Supply company of Chicago, speak particularly of the steady run they are having on Ajax batteries. Their record in a long time test now carried on, bears out, it is asserted, all that has been claimed for the Ajax.

H T. Paiste of Philadelphia, has issued a neat calandar for 1891. The engraving on the front represents a young girl in the act of dressing her hair. Preceding each month are six lines of rhyme, calling attention to the qualities and uses of the various Paiste specialties. The rhymes were written by friends of Mr. Paiste, who had offered prizes for the lines. On the back of the calendar is printed an illustrated description of the specialties Mr. Paiste manufactures.

The Humphrey Electric company of 43 Rowland street, Detroit, Mich., do all kinds of electrical repairing, making a specialty of large work. They have repaired some of the largest armatures in the city with satisfaction to their customers. They send out experts to test and rearrange plants. R. S. Campbell is the electrician of the company and H. H. Humphrey is general manager. They will soon move into a large factory where their facilities will be greatly increased. They claim to have as fine a set of testing instruments as can be found in the State of Michigan.

The St. Louis *Globe Democrat*, in a New Year's article, speaks as follows of the Heine safety boiler: Among the important industries of our city which has grown from a small beginning to a large and constantly increasing size is the manufacture of the patent Heine safety water tube boiler by the Heine Safety Boiler company, whose offices are located on the seventh floor of the Bank of Commerce building. This company has extended its trade from Maine to California, and from British America to the Gulf, and the demand for the boiler is rapidly increasing, as shown by orders from nearly every State in the Union, from Mexico, Cuba, Alaska, South America. Some large plants have been recently erected by the Heine Safety Boiler company in the Eastern States especially for electric light and electric railway companies, and the boilers have given such great satisfaction and such decidedly favorable economical results that the Heine Safety Boiler company has booked the fifth and sixth duplicate order from many of their customers.

The Pittsburg Reduction company, manufacturers of aluminum, make the following statement relative to the present prices of that metal: "We find our business impeded and our financial standing injured by the many statements printed in the papers, to the effect that other companies are manufacturing aluminum, or have processes for manufacturing aluminum, at wonderfully small costs. In giving quotations for aluminum we are constantly met with the statement that this and that paper says that aluminum is being made, or can be made, by such and such parties at figures much below that at which we are selling the metal. Now, as a matter of fact, as stated before, we find no competition for our aluminum by actual sales at less prices than we quote, namely, $2 per pound. We have reduced our prices lately to $2 for all quantities, instead of for large quantities only. We feel confident that if there was any aluminum on the American market at less than the rates which we quote, we would very soon have the matter brought to our attention by our regular customers, who are paying our price for the metal. In so far as we know, we are the only manufacturers of the pure metal in this country, and the Cowles Electric Smelting & Aluminum company are the only manufacturers of aluminum alloys other than ourselves. All of the wonderful processes which have been written about in the papers have proven to be either myths, or worse than that, many of them actual frauds."

Electrical Patents.

Issued December 30, 1890.

443,493 Telephone. Sigmund Bergmann, New York, N. Y.

443,494 Telephone. Sigmund Bergmann, New York, N. Y.

The second claim is:

"In a telephone transmitter, the combination, with a diaphragm of two magnetized steel rods making an end contact controlled by the movement of the diaphragm."

443,497. High Resistance Compound. William G. Bremer, St. Louis, Mo.

The invention consists of a compound of graphite and shellac.

443,505 Telegraph Blank. John O. Donnell, Lowville, N. Y.

443,508. Pole Top for Trolley Wire Support. William L. R. Emmet, East Rockaway, N. Y.

The first claim is given:

"The combination of a metal pole, a plug or block of insulating material attached to the upper end of said pole, a hollow metal top resting upon said plug or block and inclosing a portion of the top of said pole, and a sleeve of insulating material inserted between said pole and said top."

443,526. Telephone. Edward H. Johnson, New York, N. Y.

The invention consists in the combination of a number of sets of electrodes and independent controlling devices spirally arranged.

443,527. Apparatus for Automatically Grounding or Cutting out of Circuit Exposed Electrical Conductors. Francis W. Jones, New York, N. Y.

443 530. Socket for Electric Lamp. Charles A. Lieb, New York, N. Y.

443,536. Art and Means for Covering and Insulating Wire. Thomas W. Norman, Boston, Mass.

443,543. Key Turner for Gas and Electric Lights. Lewis H. Rockafellow, Philadelphia, Pa.

443,551. Machine for Covering Electrical Conductors with Lead. Francis H. Stillman, New York, N. Y.

443,556. Secondary Battery. Harry W. Wardwell, Lake Village, N. H.

443,557. Arc Lamp Alonzo W. Whitcomb, Worcester, Mass.

443,562. Incandescent Lamp Socket. Sigmund Bergmann, New York, N. Y.

443,563. Shade Holder for Incandescent Lamps. Sigmund Bergmann, New York, N. Y.

443 565. High Resistance Compound. William G. Bremer, St. Louis, Mo.

The composition or compound consists of rubber, shellac and graphite.

443,580. Electrical and Vapor Face Bath. Nathaniel Lyke, Williamsport, Pa.

443,598. Apparatus for Preventing Steam Boiler Incrustation. John Langstaffe, Battersea, England.

443 606. Switch. Edward H. Johnson, New York, N. Y.

443,632. Electric Arc Lamp. Edward Heymann and Frank W. Heymann, Boston, Mass.

443,633 Electric Arc Lamp. Edward Heymann and Frank W. Heymann, Boston, Mass.

443 636. Apparatus for Measuring and Registering Electric Currents. Camille A. Faure, New York, N. Y.

443,642. Electric Meter Chaimsonovitz P. Elieson, London, England.

443,646. Magneto Electric Stop Mechanism. Washington H. Kilbourn, Greenfield, Mass.

443 661. Traction and Brake Device for Electric Railways. Rudolph M. Hunter, Philadelphia, Pa

443,671. Electric Locomotive. Rudolf Eickemeyer, Yonkers, N. Y.

443 674. Electric Stop Motion for Warping Machines. Philipp Goldschmidt, Paterson, N. J.

443,677. Traction and Brake Device for Electric Railways. Rudolph M. Hunter, Philadelphia, Pa.

443 693. Electric Switch. James J. Wood, Brooklyn, N. Y.

443,716. Electric Damper Regulator. Jeremiah O'Meara, New York, N. Y.

443,724 Electrical Fire Alarm and Extinguishing System. Charles E. Ongley, New York, N. Y.

443 725. Non-Interfering Signaling System. Charles E. Ongley, New York, N. Y.

443,726. Electrical Signal System. Charles E. Ongley, New York, N. Y.

443 727. Safety Device for Dynamo Stations. Charles E. Ongley, New York, N. Y.

Claim one reads as follows:

"The combination with an engine or motor, a dynamo driven thereby, and a cut-out directly in the dynamo circuit, of a local circuit, a device for stopping the flow of current from the dynamo to the cut-out and line, and a magnet in said local circuit controlling said device."

443 746. Electric Lamp Socket. John T. Dempster, Summit, N. J.

443,748. Method of Electric Soldering and Cementing Cans. Mark W. Dewey, Syracuse, N. Y.

443,749 Apparatus for Electric Soldering and Cementing Cans. Mark W. Dewey, Syracuse, N. Y.

443,772 Electro Magnetic Clutch Charles E. Kells, Jr., New Orleans, La.

443,787. Watchman's Electric Time Recorder. Charles E. Ongley, Yonkers, N. Y.

443 788. Watchman's Electric Time Recorder. Charles E. Ongley, New York, N. Y.

443,789. Electric Valve Controller. Charles E. Ongley, New York, N. Y.

443,790. Electrical Protective and Signaling System. Charles E. Ongley, Yonkers, N. Y.

443,814. Electrical Attachments for Railway Switches. Arthur W. Berne, New Orleans, La.

443,823. Apparatus for Laying Electric Conductors. Thomas J. Cope, Philadelphia, Pa.

443 824. Apparatus for Laying Conductors in Conduits. Thomas J. Cope, Philadelphia, Pa.

443 834. Electric Annunciator. John W. Luthe and Alfred E. Jeavons, Cleveland, Ohio.

443 944. Attachment for Electric Arc Lamps. James A. Manning, Ashtabula, Ohio.

443,976. Galvanic Battery. George A. Smith, Halifax, Canada.

443,980. Electric Motor. Charles J. Van Depoele, Lynn, Mass.

The invention comprises a wire wound armature, means for connecting the armature conductor into one or more circuits, a surrounding stationary coil inducing magnetizing currents in the armature, and field magnet reacting upon the poles of the armature.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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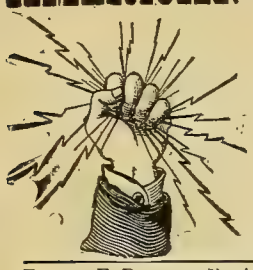

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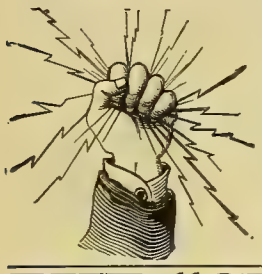

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The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

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HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

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Notice is hereby given that bids will be received by the city clerk up to 12 o'clock noon, January 19, 1891, for lighting the city of Chillicothe, Missouri, for a period of from 3 to 5 years with not less than 30 arc electric lights of 2,000 candle power, each to run all night each night in the year. Plant to be in operation by March 1, 1891.

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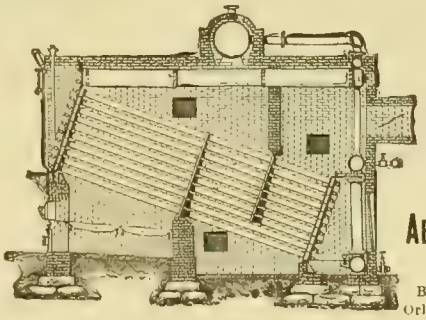

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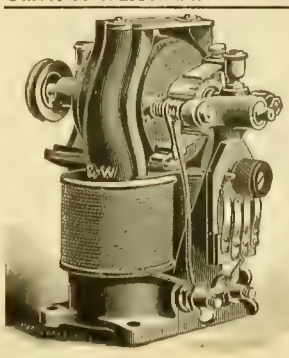

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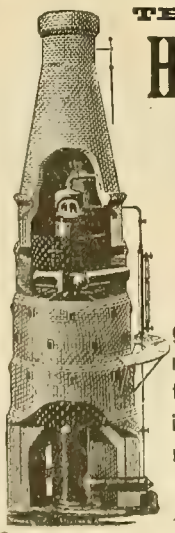

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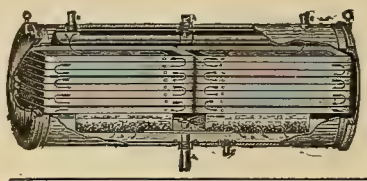

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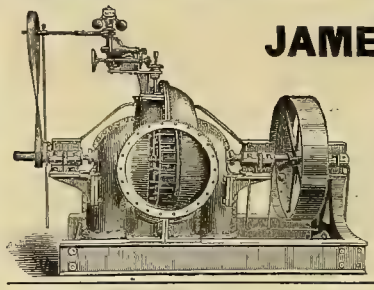

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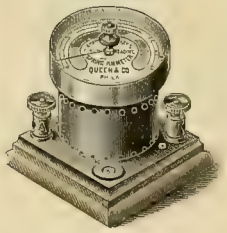

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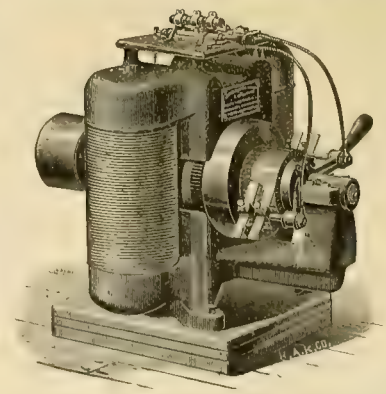

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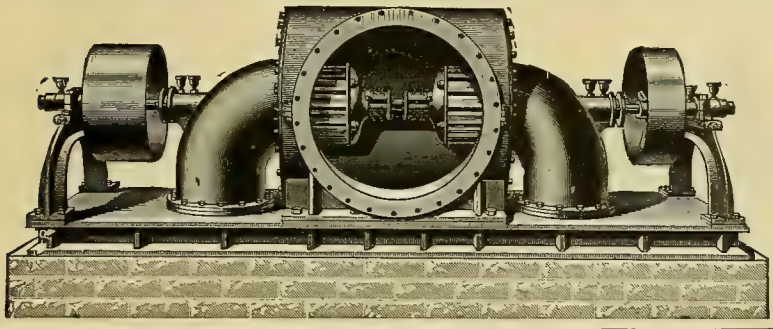

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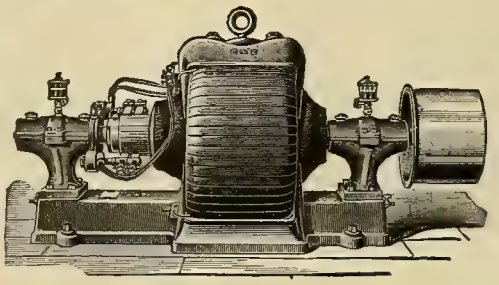

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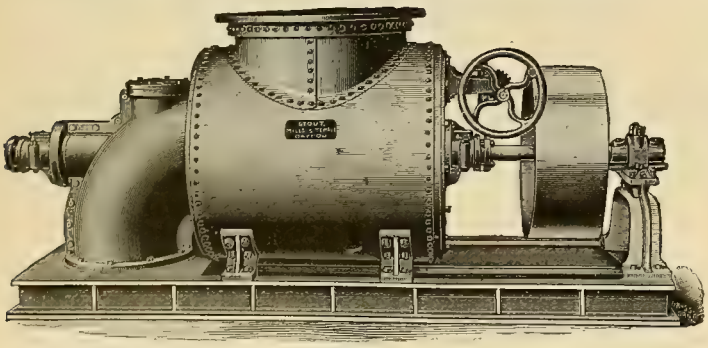

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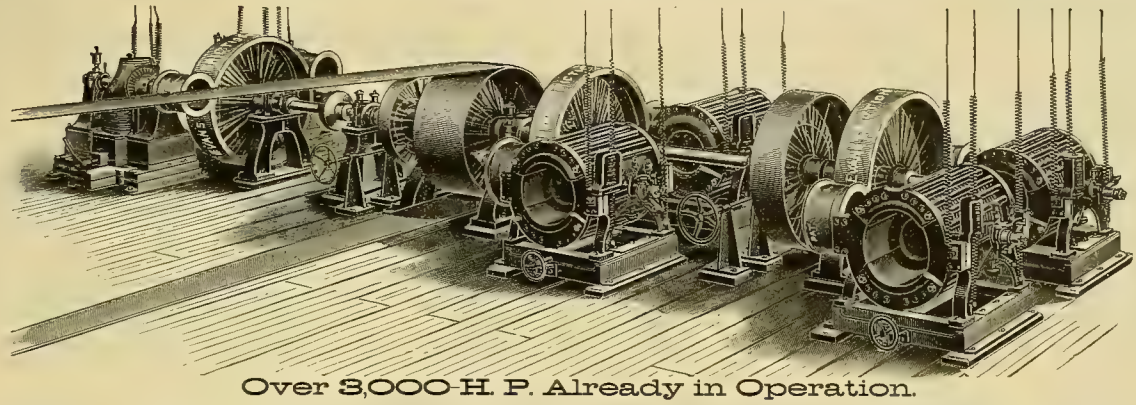

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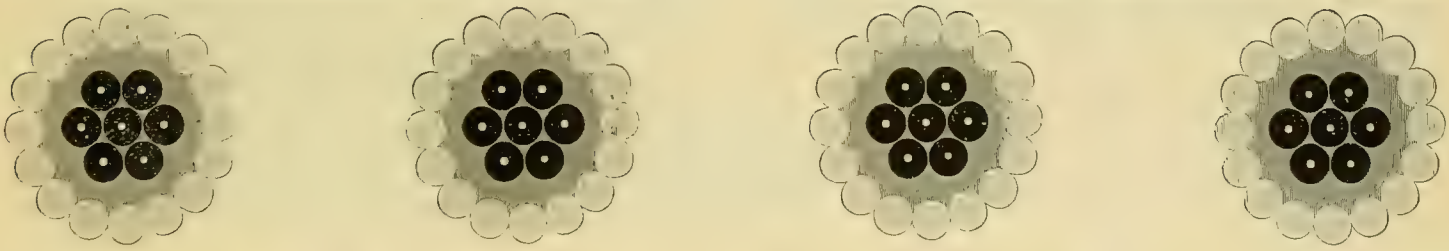

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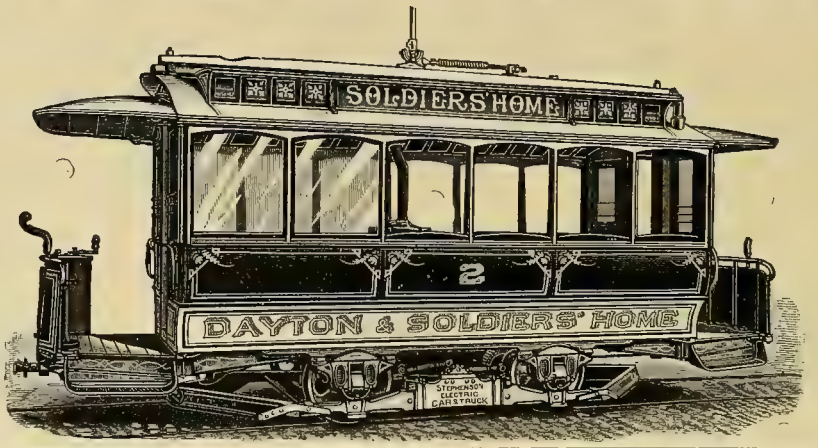

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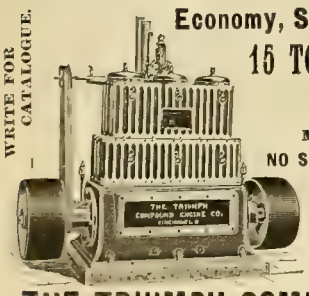

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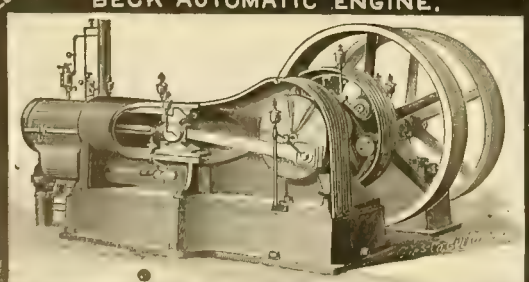

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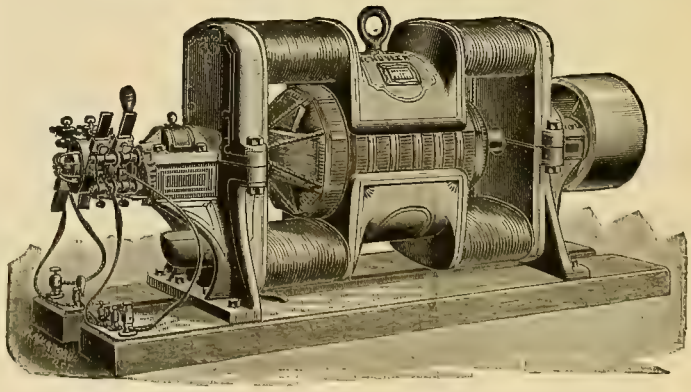

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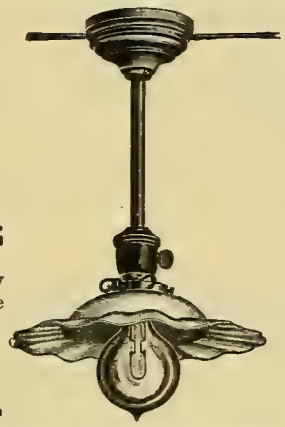

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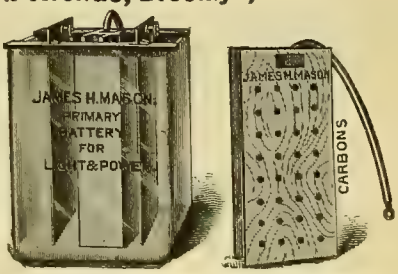

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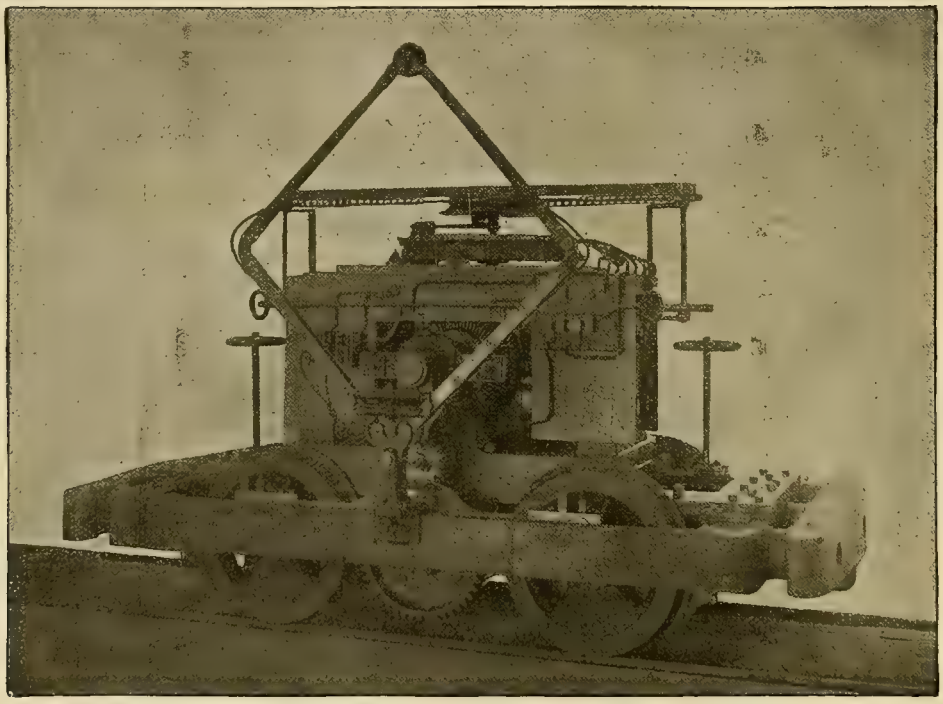

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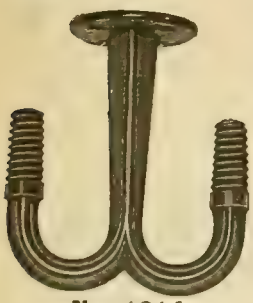
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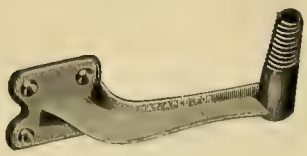
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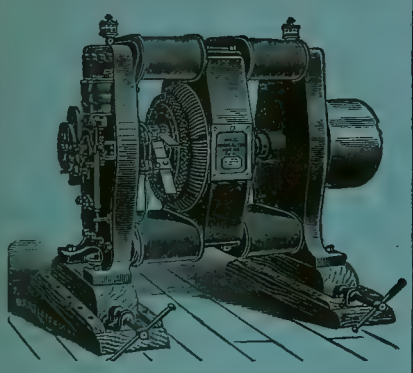

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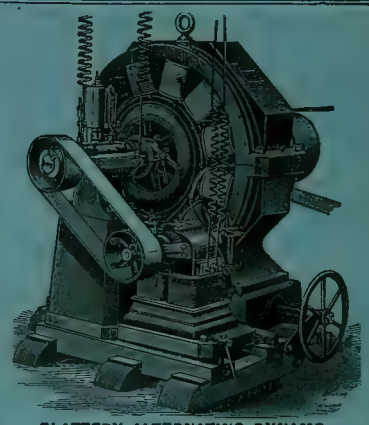

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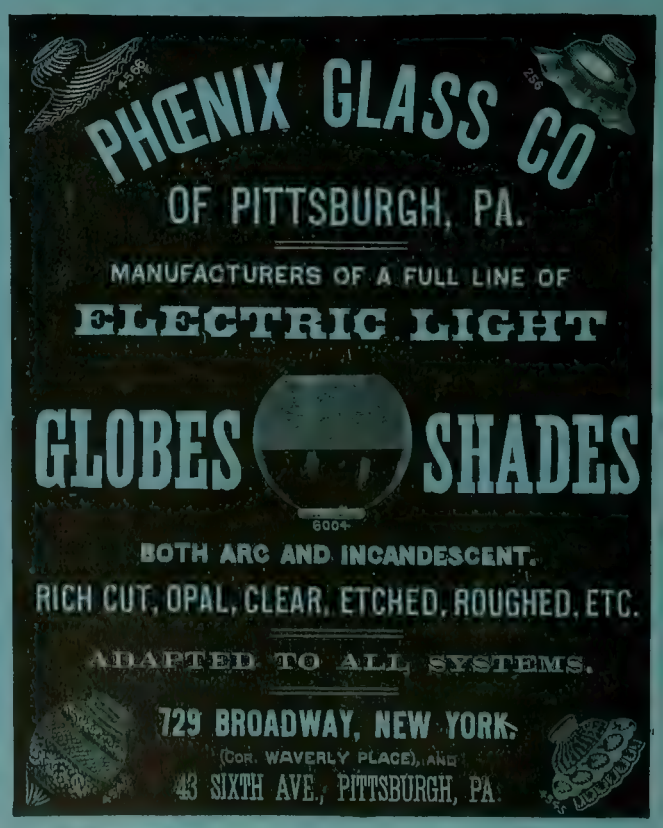

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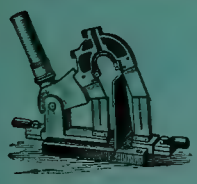

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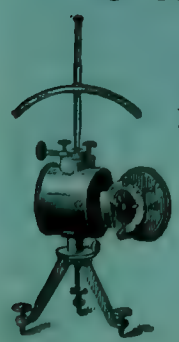

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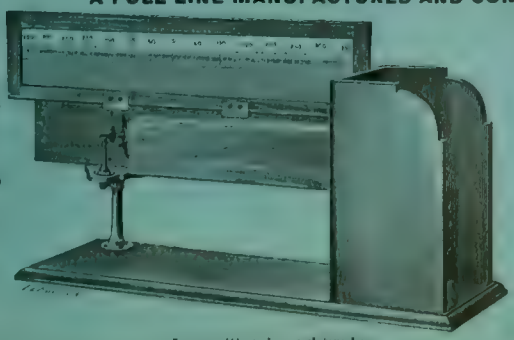

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$67\frac{4}{5}\%$	$71\frac{2}{5}\%$	100%

Were using Thomson-Houston apparatus, as evidenced by the following figures.

The figures referring to "total of all systems," taken from table published in August number of "Electrical Industries," are of undisputed accuracy.	Total of all systems.	Thomson-Houston System.	
		Number.	Percentage to total of all Systems.
Minnesota, - - -	28	19	$67\frac{4}{5}$ per cent.
Mississippi, - - -	7	5	$71\frac{2}{5}$ per cent.
Montana, - - - -	9	9	100 per cent.

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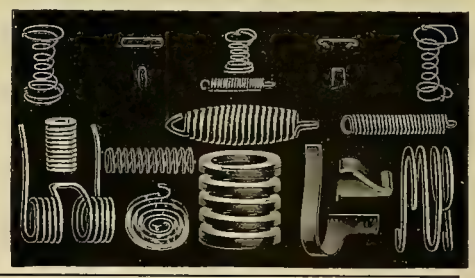

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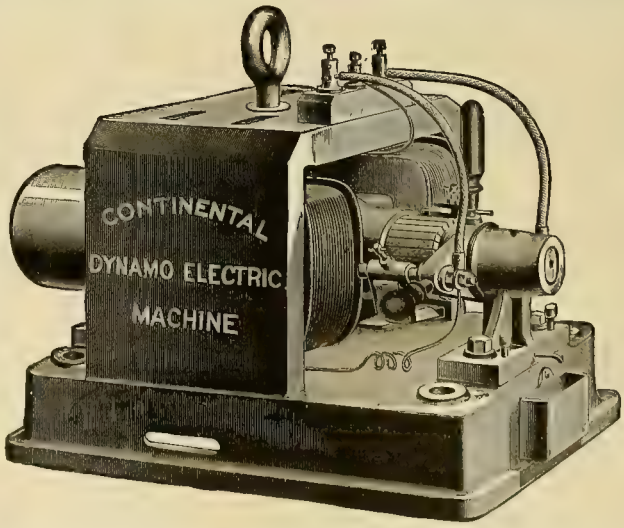

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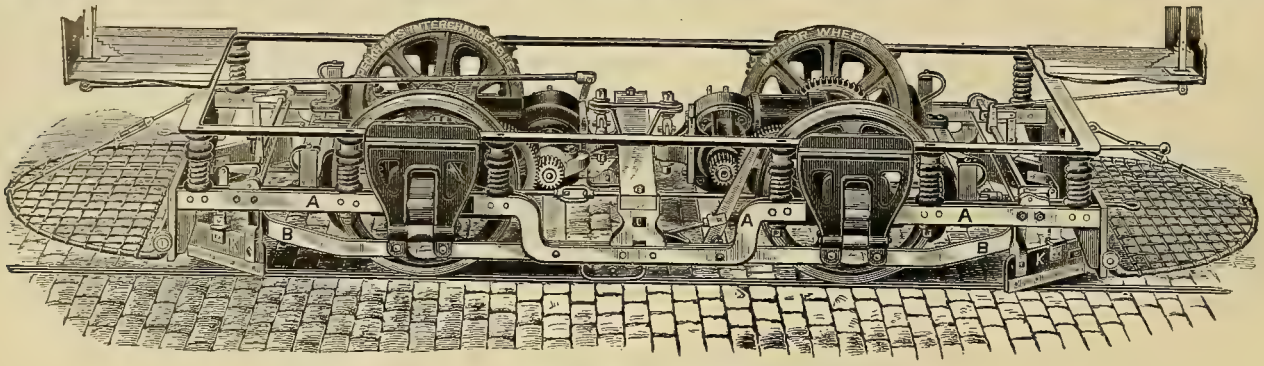

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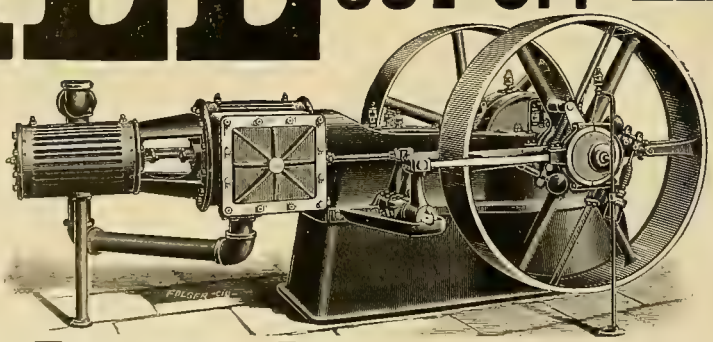

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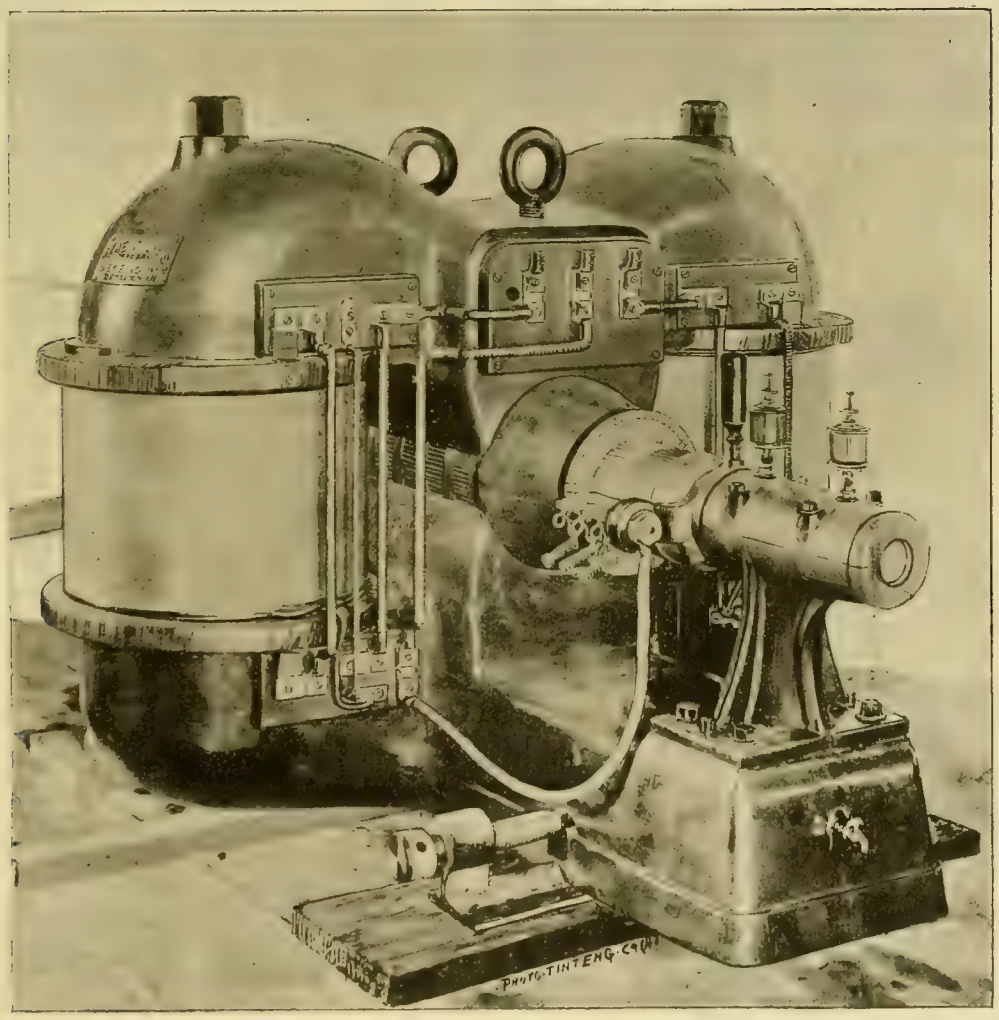

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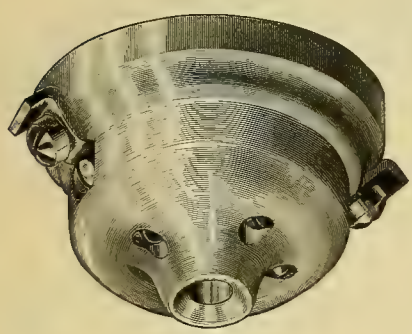

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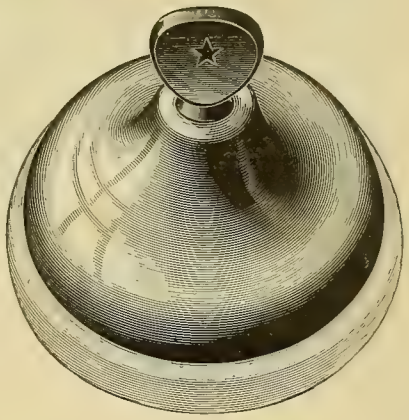

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79 and 81 Washington Street, Brooklyn, N. Y.

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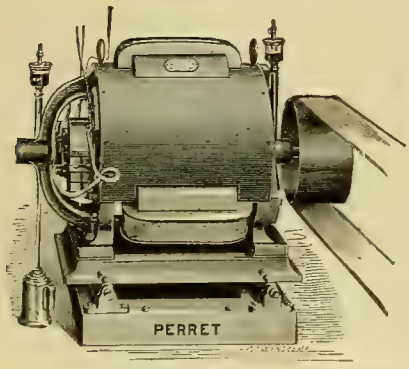
Perret Electric Motors and Dynamos



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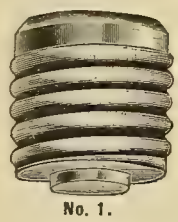
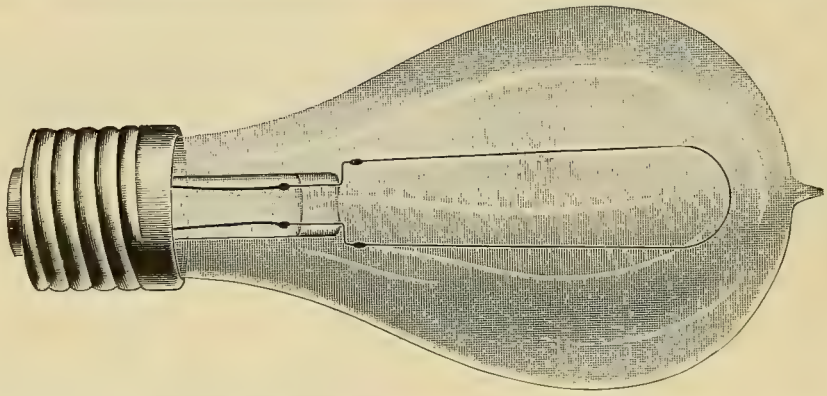
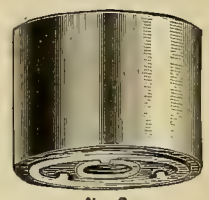
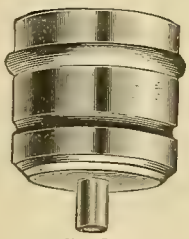


No. 1.
Edison Base.





No. 2.
Thomson-Houston Base.



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Unless otherwise specified, all lamps will be shipped with No. 1 Bases. The other Bases, Nos. 2, 3 and 4, will be placed on lamps, when so ordered, without extra charge.

No. 4.
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16 C. P. Lamps, List Price, 80 Cents Each.		Net Price.
Discount in Lots of 25 to 150, - -	*45 per cent.*	*44 cents each.*
Discount in Lots of 150 to 500, - -	*47½ per cent.*	*42 cents each.*
Discount in Lots of 500, - - - -	*50 per cent.*	*40 cents each.*

Discounts for Larger Lots Quoted on Application.

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DURABLE. EFFICIENT. ECONOMICAL.

Write for Circulars and Price List to nearest District Office, or any Electrical Supply House.

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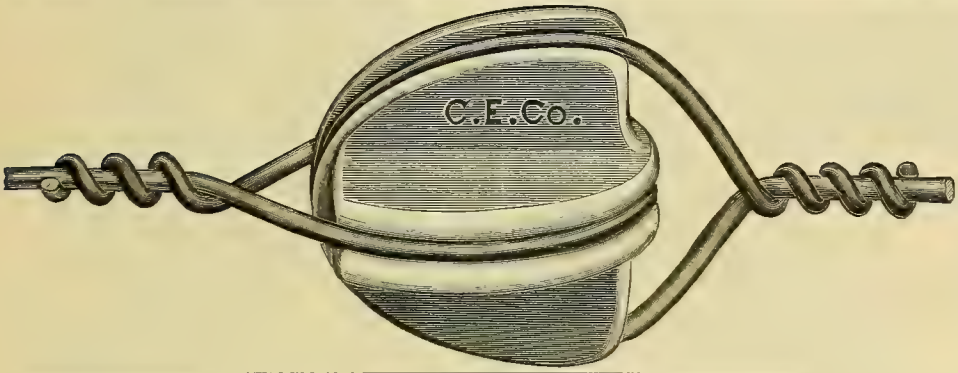
IMPROVED
CANDEE WIRE.

We take pleasure in presenting to the trade two new specialties in Insulators that must commend themselves to every practical construction man as being the best things of their kind in the market.



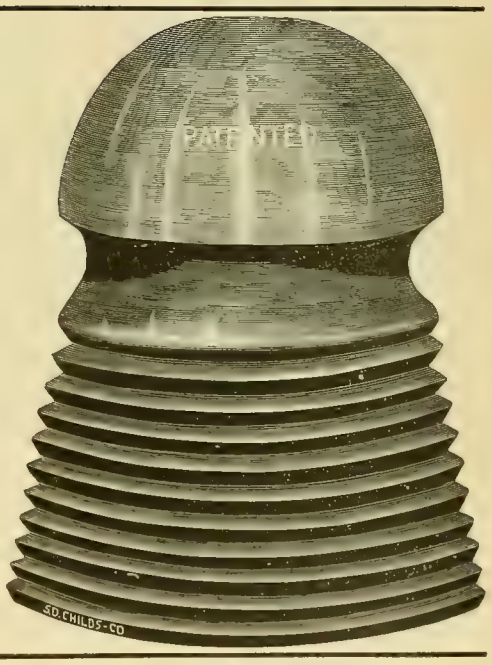
THE
Bain Break Insulator

For Suspending Arc Lamps, Insulating Guy Wires, Insulating Span Wires in Electric Railroad Work, is so simple and perfect in construction as to need no explanation.

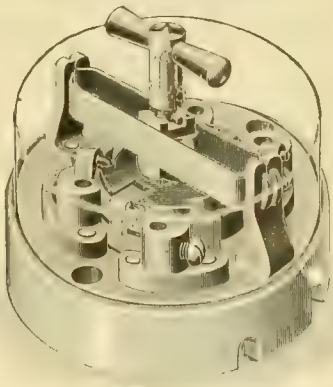
THIS NEW

HIGH RESISTANCE GLASS INSULATOR

Is made of extra heavy glass, and is especially designed for large Electric Railroad Feeder and Primary Electric Light Wires. The glass surface between the Wire and Pin is more than doubled as compared with the ordinary Insulator.



We can also offer attractive prices in specially prepared Fuse Wire, Perkins' Switches, K. W. Cut-Outs, and everything Electrical worth having.



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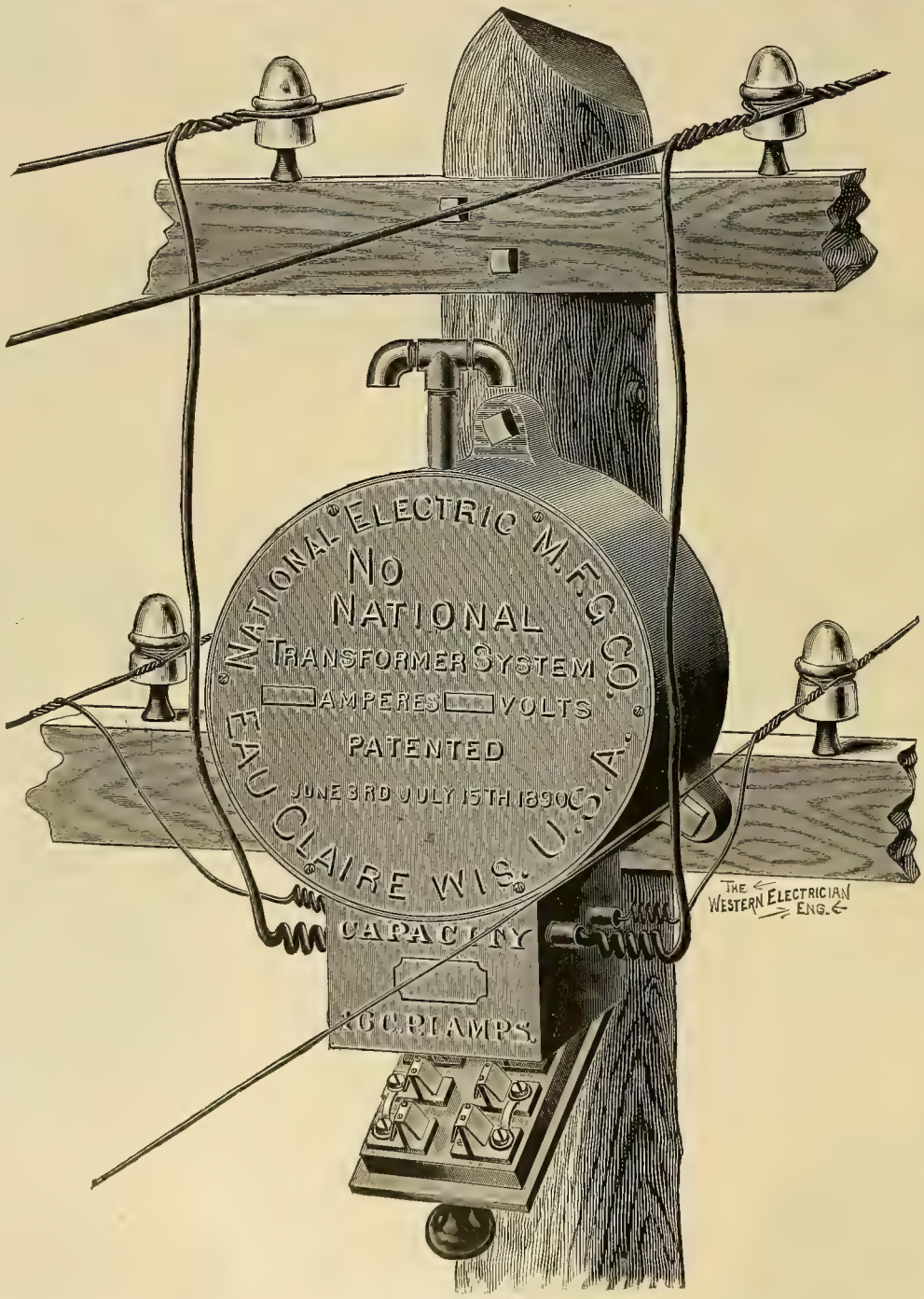
CONVERTER EFFICIENCIES.

It will PAY YOU to throw out your present transformers and substitute OUR MAKE.

No more Accidents from Grounded Circuits.



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They are the most efficient, {95.2%.} They are absolutely safe. Their regulation is practically perfect.

Transformer on Pole Showing National Safety Fuse Box.

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HIGHEST EFFICIENCY,
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CHAS. M. BLANCHARD, Agt., - - - - Girard Building, Philadelphia, Pa
L. N. COX, Agt., - - - - - - - 16 Fifth St., S. E., Washington, D. C.
W. N. GRAY, Special Agt., - - Room 12, Chamber of Commerce, Cincinnati, O
NATIONAL ELECTRIC MFG. & CONSTRUCTION CO., Tower Bldg., 50 Broadway, N. Y. City.
NATIONAL ELECTRIC DEVELOPMENT CO., - 314 California St., San Francisco, Cal.
SIMPSON-DAVIS ELECTRICAL CONSTRUCTION CO., Agts., - - Winnipeg, Manitoba.
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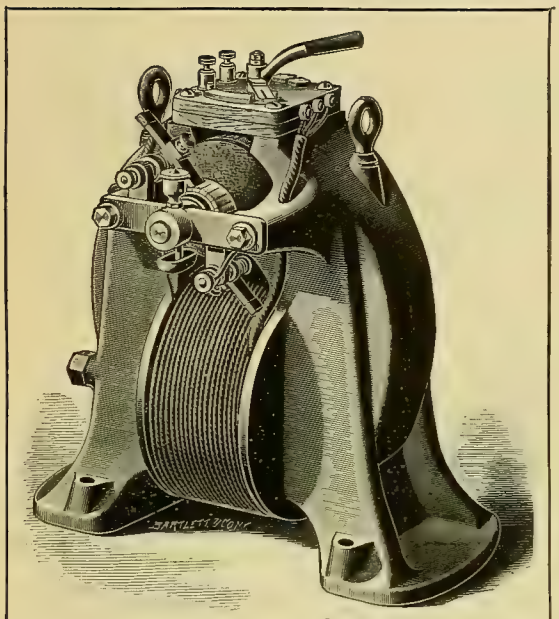
THE UNITED STATES ELECTRIC LIGHTING CO.,

(THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Lessees.)

ARC AND INCANDESCENT ISOLATED ELECTRIC LIGHT PLANTS.



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More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

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MOTORS and GENERATORS

Direct Current GENERATORS and MOTORS for all purposes, 1-8 H. P. up to any power required, and at any required E. M. F.

Superior in Design and Workmanship, and Unequaled in Efficiency.

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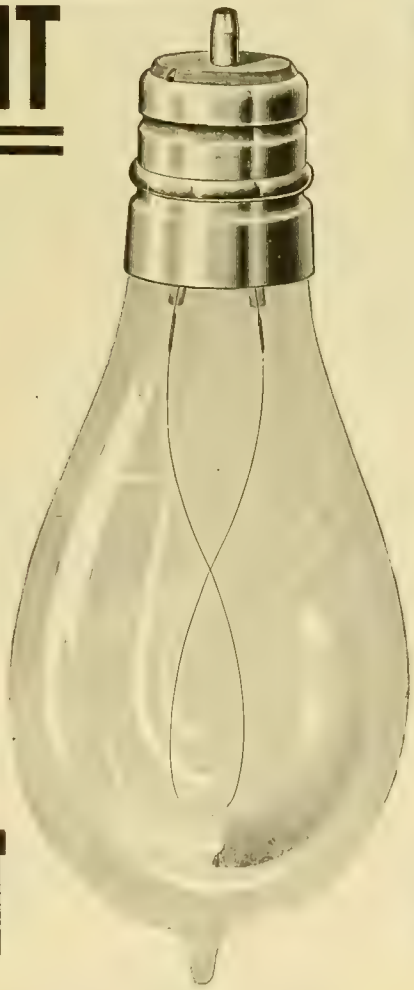

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FROM 8 c. p. to 150 c. p., AND ANY VOLTAGE.

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H. H. HIPWELL, Prop.
Mfrs. of Electric Specialties of Every Variety, TOOLS, DIES, Etc.
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ANNUNCIATORS AND BELLS.
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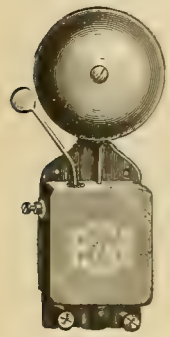
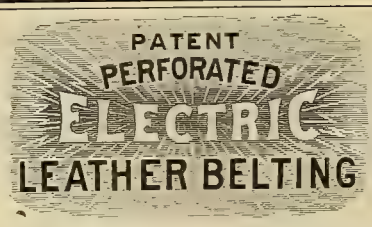


It gives me much pleasure to say that in my experience with your celebrated S. & H. Bell, I have had the most satisfactory results; in one case, out of 136 bells in a building, each of which are used several times daily, there has not been one instance where there has been trouble in the two years they have been in use.

Yours truly,
EMIL GRAH,
Toledo, Ohio.



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PATENTEES AND SOLE MANUFACTURERS,
Also New York, Boston, Philadelphia. 46 SOUTH CANAL ST., CHICAGO. ILL.

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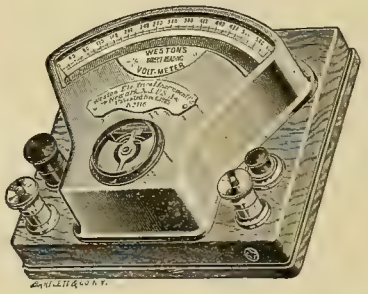
Voltmeters and Ammeters.



These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

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FOR INSIDE WORK USE "BISHOP" WHITE CORE WIRES.

"ELECTRIX" INCANDESCENT SNAP-SWITCHES, CUT-OUTS, ROSETTES, SOCKETS, INSULATING JOINTS, GAS ATTACHMENTS, ETC.

ALL FIRST-CLASS GOODS. REASONABLE PRICES.
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ARE ESPECIALLY APPLICABLE TO
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A simple solution of the Wiring Problem for Public Buildings, Residences, Factories, Station Work, Cars, Underground Feeders, and in all places where Insulation is required.

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—FOR—
1891.

The manufacturer of the Paiste Electrical Specialties tried to remember all who are interested in electrical work and sent them a fine engraved Calendar for 1891, on the back of which are printed illustrated pointers about their specialties, a handy thing to have in your office. If yours did not arrive, send postal and you will receive one.

H. T. PAISTE,
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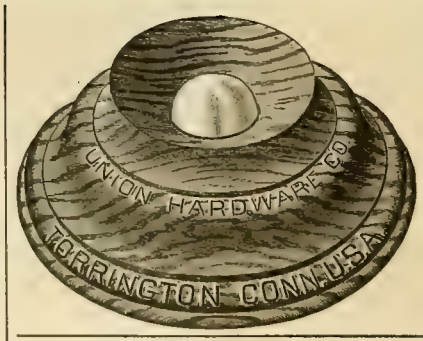
THE PAISTE SPECIALTIES,
SWITCHES, CUT-OUTS, SOCKETS,
Are kept in stock and for Sale by all prominent Supply Houses.



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95 CHAMBERS STREET, NEW YORK.

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Western Electrician.

EVERY SATURDAY.

Vol. VIII. CHICAGO, JANUARY 17, 1891. No. 3

Edison Station at Des Moines, Ia.

The accompanying cuts represent the new plant of the Edison Electric Light company of Des Moines, Ia. The dynamo room, shown in Fig. 1, is well adapted to the demands of the company, and is admirably arranged and appointed. A view of the power house is given in Fig. 2.

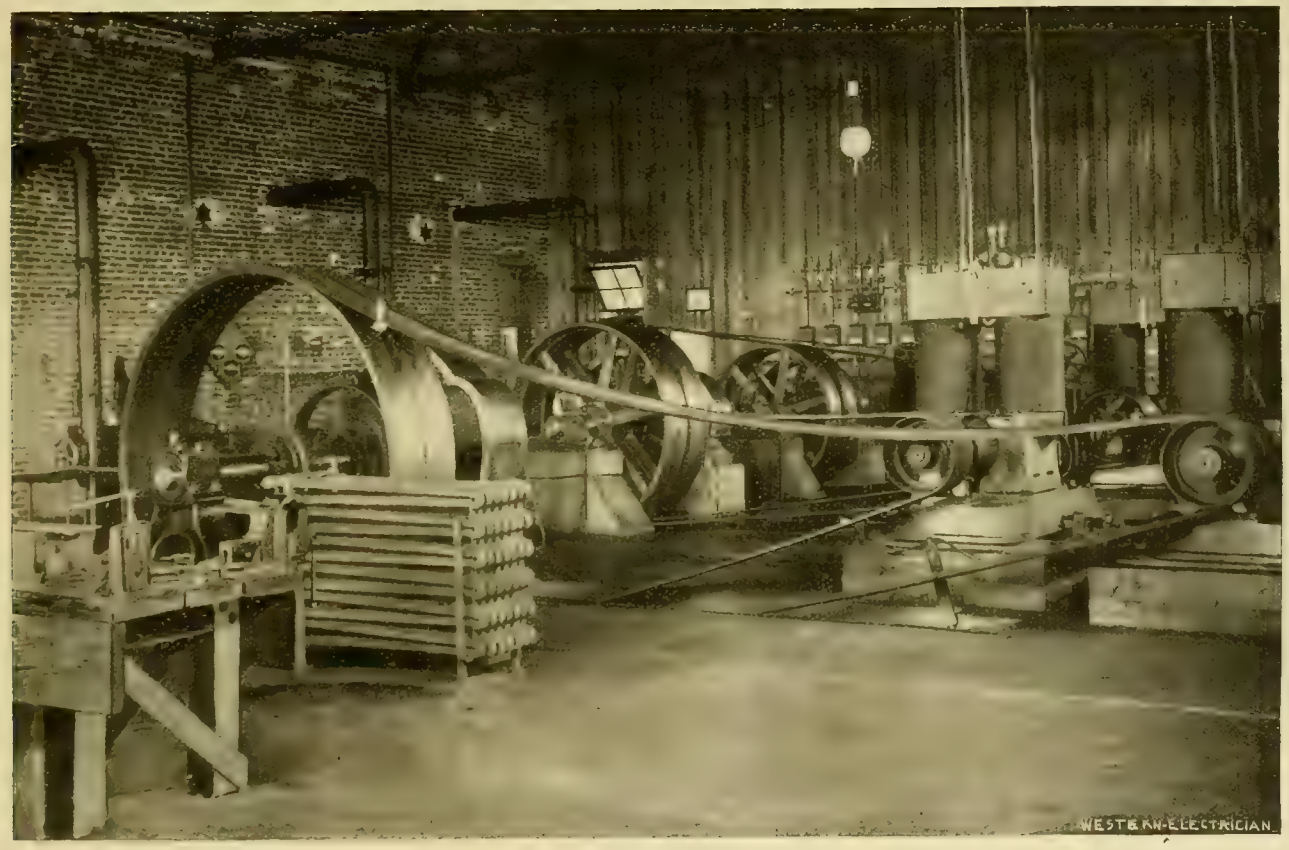
The original plant of the company was the first Edison station equipped in Iowa. It was located in the business center of Des Moines, and for five years supplied that city with incandescent light. At that time the demand outgrew the capacity of the plant.

The new station herewith illustrated is on the river bank. Considerable new machinery was installed, and the station now has a capacity of 10,000 lights. It is so arranged, however, that the capacity may be greatly increased, and the growing demand for incandescent lights leads the company to believe that it will soon be called upon to introduce additional machinery. At present six generators are employed. They are operated by one Buckeye and two high speed Williams engines, with vacuum pump attachment.

The water used is taken from the river, filtered through cobbles and gravel to a large cistern, thence through charcoal filters to two auxiliary boilers, and from these boilers it runs in an absolutely pure condition to the boilers proper.

The switch-boards, like everything about the new station, are of handsome design. Back of the dynamo and boiler rooms are three storerooms and a meter room. The offices are in the front of the building, and are admirably arranged.

The street system of the company was rebuilt throughout in 1889, and during the last year $20,000 was expended in the extension of the system. The new station was built under the personal supervision of J. A. Colby, manager and secretary of the company.



EDISON ELECTRIC LIGHT STATION AT DES MOINES, IOWA

Telegraph Lines in Chicago.

While Supt. Tubbs of the Chicago office of the Western Union Telegraph company, was out of town last week, one of his assistants ordered a gang of men to replace several old poles on the North side with new ones. While the work was in progress, City Electrician Barrett learned of it and notified the men to quit work. The poles were within the dead line and the wires which they carried will be placed underground in the spring. The employe of the company who ordered the new poles substituted, was not aware of the fact that an agreement to this effect had been reached. The Western Union and Telephone companies have placed a large number of wires under ground during the last year.

National Electric Light Association.

The electrical exhibition to be made at Providence in connection with the convention of the National Electric Light association February 17, 18 and 19, promises to be unusually interesting. Gen. C. H. Barney of New York, of the committee on exhibits and transportation, reports that nearly all the space in the exhibition hall has already been reserved. The committee expects that all applications for space will be made at once, so that proper arrangements can be made.

Municipal Control of Electric Plants.

"Politicians are not good men to conduct business enterprises," remarked the superintendent of one of the largest arc lighting companies in the country. He had just been reading an article in the WESTERN ELECTRICIAN on the project of Mayor Cregier to have the city engage in commercial lighting. Continuing, he said: "The men engaged in municipal politics to-day are not, as a rule, capable of managing any business enterprise that rises above the level of a barroom. Not one business man in five hundred in the city of Chicago would trust these local politicians in any private venture, yet these fellows have the audacity to assume that they can conduct immense business enterprises. The fact of the matter is they care nothing for the 'dear public' notwitnstanding all their protestations and honeyed words. They are contemplating a raid of magnificent proportions on the public treasury. It is a desire to secure public pap and political strength that is at the bottom of all this agitation for the change."

Any person who has had experience in local politics will appreciate the force of these remarks. They are specially applicable to the city of Chicago where every department of importance is permeated with politics, thereby greatly hampering public service. The people of Chicago are beginning to realize the signifi-

cance of placing additional power in the hands of incompetent men, and a revulsion of feeling is becoming apparent. The burden of taxation, already very heavy, of course would be increased. The political bosses will require munificent reward for delivering the public from the grasp of corporations. Of course these statesmen, patriotic though they be, cannot serve the public free of charge. At any rate, they have always demanded adequate compensation for their services, and they will not now depart from the rule.

In view of these facts it is a wonder that the people would seriously contemplate for a moment such a preposterous scheme. It is earnestly to be hoped that they will be brought to a realization of the true state of affairs before they allow themselves to be plunged into the evils of communistic management of private enterprises. But Chicago is not the only place where Bellamy's rainbow reforms are seriously considered. New Haven has a mayor who seems desirous of securing notoriety similar to that which Mayor Cregier has been seeking. This last disciple of Bellamy agrees with Mayor Cregier "that all works of a public nature, carried on mainly within the bounds of a municipality, and for the purpose of supplying the inhabitants with certain daily requirements of civilized life, and requiring special rights of eminent domain to distribute their products should be owned and operated by the people, and in the sole interest of the people." In order to enable New Haven to go into the gas and electric lighting business, and to own and run the bobtail cars, he would borrow the necessary capital "on city bonds, at low interest and distant maturity." This is in pursuance of the Bellamistic scheme as outlined in the "First Steps toward Nationalism." The mayor in addition to advocating municipal control of electric and gas plants, horse cars, etc., wants municipal bands of good musicians to play tunes in the public parks. "There are no influences," remarks the mayor, "so potent, beneficent and economical as music 'to drive dull care away, and soothe the weary."

If the mayors of Chicago and New Haven would confine their demands to public music there would be much less cause for complaint. The corporations now assailed would undoubtedly be willing to furnish bands to play before the residences of the chief magistrates of all large cities if they would be permitted to conduct their business in peace.

Wilson, N. C., will issue bonds for $15,000 for the erection of an electric light plant.

Chicago Telegraphers' Reception.

Years ago the telegraphers of Chicago made it their custom to give an annual ball. These gatherings were attended by knights of the key from the cities and towns surrounding Chicago, and were very enjoyable affairs. It has been decided to revive the custom, and the fraternity will give a ball at the Second Regiment Armory, Chicago, Friday evening, Feb. 6th. The following committees are in charge:

Reception Committee: W. J. Lloyd, H. G. McGill, F. J. Norris, G. W. Felton, H. S. Waters, Henry Behl, J. B. Inman, E. S. Patten, J. C. Barclay, E. A. Patterson, F. T. Mullen, D. S. Anderson, Chas. Matthias, W. R. Halligan, M. D. Mason, N. W. Watson, W. A. Wallace, Thos. Burke, M. McCulloch.

Committee of Arrangements: N. M. Kent, Jos. Laird, F. M. Crittenton, W. A. Dillon, W. H. Mills, John Savoy, J. J. Burke, C. H. Finley, J. S. McCurdy, B. F. Maloney.

Electricity in Agricultural Work.

As an agent for the distribution of power electricity has found its way into almost every branch of industry. One of the encroachments of the electric motor is in the domain of the farmer. The cuts illustrate machinery by which it is proposed to reduce farm labor to a minimum. The plan proposed by E. M. Bentley of New York, the inventor, is to equip a farm with what he calls an electric agricultural system which consists of an electric generator supplying conductors hung across the fields and so arranged that a current may be drawn off to actuate electrical agricultural implements.

Referring to the cuts, Fig. 1 represents the general arrangement of the conductors, Figs. 2 and 3 show the electric mowing machine and the plow. Fig. 4 shows the arrangement of the traveling cross conductors which supply current directly to the implements.

In Fig. 1, *A* and B are two main conductors extending along a farm or other large district. The lines *C* represent transverse wires hung along the edges of definite fields or districts. It is intended that these wires *C* shall be readily removable from their supporting-posts by being provided at intervals with sockets adapted to fit pinions on the ends of the posts. Where the wires *C* connect with the main wires, switches *E* are provided, by which each wire can be connected with either *A* or *B*. Each mowing machine or plow carries a trolley pole with two contact wheels. In Fig. 2 the rotary motion of the motor is converted into a reciprocating motion which is communicated to the knives of the machine by a train of gearing. The motor itself is supported at one end upon the axle and

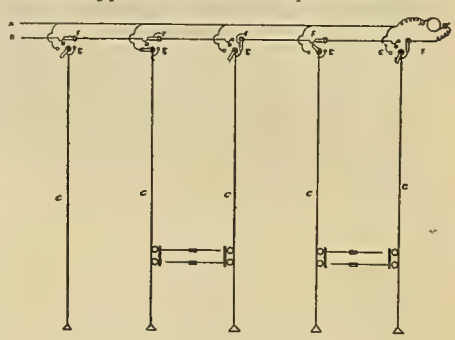


FIG. 1. ELECTRICITY IN AGRICULTURAL WORK.

at the other end on a spring on a steering-wheel, so as to have a flexible bearing.

In Fig. 3 the motor is geared, as shown, to the wheels by means of spur and bevel gears.

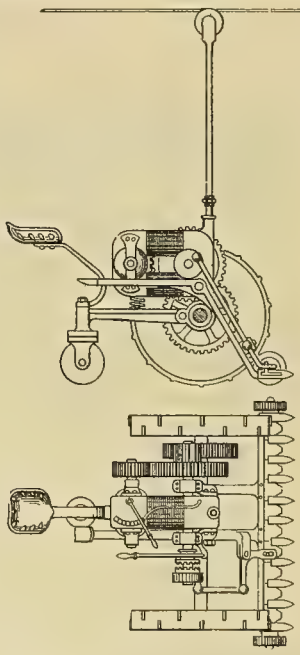


FIG. 2. ELECTRICITY IN AGRICULTURAL WORK.

The motor is also geared to a sprocket, which actuates a chain, carrying a series of plows.

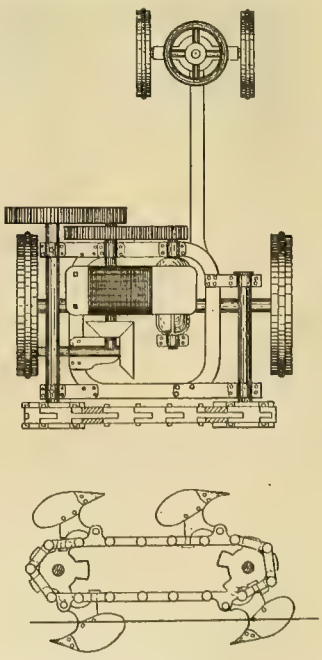
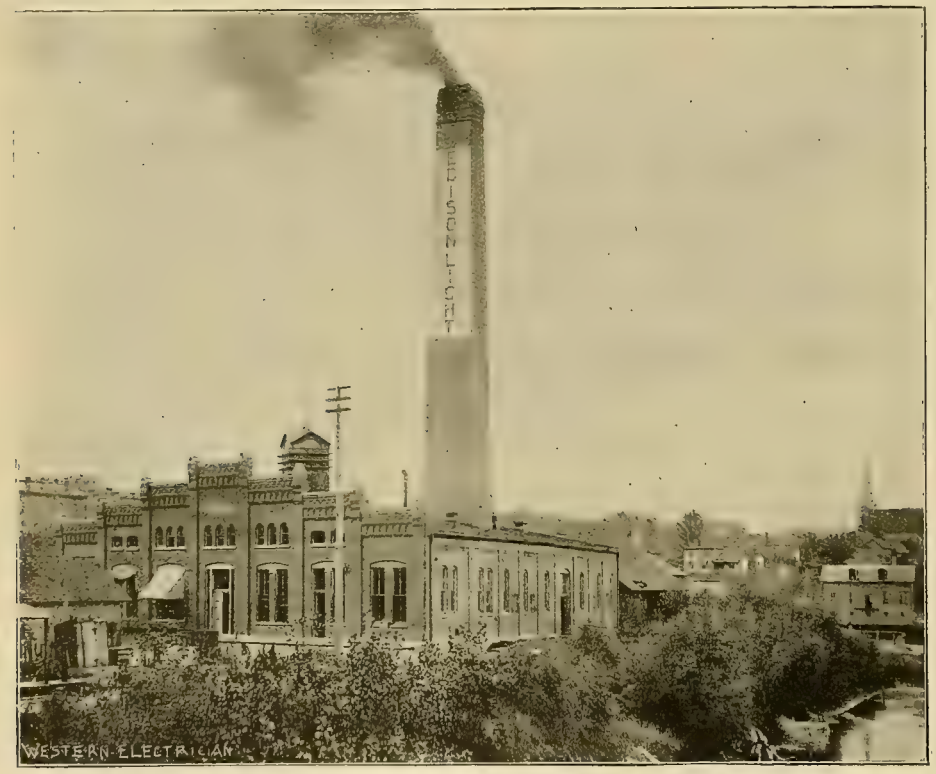


FIG. 3. ELECTRICITY IN AGRICULTURAL WORK.

These plows are supported from the chain by a spring, and are adjustable vertically by a screw. The plows come around in succession, and as the machine is constantly advancing, each one



EDISON ELECTRIC LIGHT STATION IN DES MOINES, IOWA.

takes hold in the earth at a point somewhat in advance of the previous one. They are set at an angle to the chain, so that the furrows will be at an angle to the line of forward movement of the machine.

It will be seen that the resistance offered by the earth to the plows is taken up by flanges on the wheels of the implements, which press into the ground and prevent side movement of

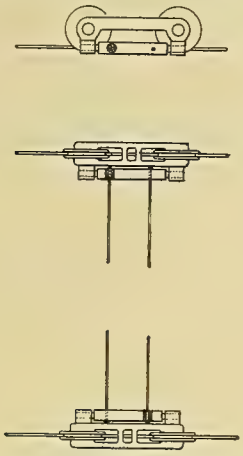


FIG. 4. ELECTRICITY IN AGRICULTURAL WORK.

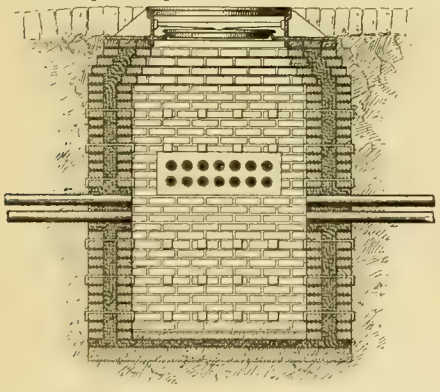
the vehicle. The plows are behind the vehicle so that the wheels will have a hard uncut surface of ground on which to ride.

Improved Vault for Electric Subways.

The fact that explosions are constantly occurring in electric subway systems in cities where the ground is more or less impregnated with gas, has brought to mind most forcibly the great necessity of making the conduits and vaults as nearly gas-tight as possible. One of the most recent attempts to produce a vault which would prevent the infiltration of gas is illustrated in the cut.

The construction of the walls and the arrangement of the vault covers will be readily comprehended. The vault proper is built in the following manner: A layer of Portland or Rosendale cement mixed with sand, gravel or broken stone, is first placed in the bottom of the excavation. Upon this base a layer of pitch or asphaltum is then spread. This coating in a plastic state is run in and becomes compact and homogeneous.

The double side brick walls are next built so as to leave, as shown, space between them. Into this space is poured and allowed to harden,



IMPROVED VAULT FOR ELECTRIC SUBWAYS.

pitch or asphaltum. The inner and outer side walls are braced by tie-plates, as is clearly indicated.

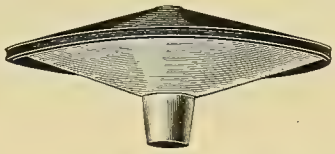
This vault was designed by W. H. Hart of Brooklyn, N. Y.

Railroad Rates to Electric Light Convention.

B. F. Knapp, secretary of the Central Traffic association, has authorized a rate of one and a third fare for round trip tickets for those who intend to start from Chicago to attend the Providence convention of the National Electric Light association. The fares to Providence by three routes are as follows: All rail via New York, $24.30; rail to New York and steamer, $22.50; all rail via Albany and Springfield, $22. Those who secure certificates at Chicago will be entitled to return fares at one-third the rates mentioned.

Smith Street Lamp Hood.

The lamp hood shown in the cut is not unlike other devices of its class in general appearance. Particular advantages are claimed for it in point of strength and finish. As it is intended mainly for outside use, the hood is substantially made to stand wind and weather. The under side of the hood is a glazed, convex reflector. The lamp is closely held at the center, and the light is thus reflected laterally as well as downward. Its weight being small, it can be extended some distance from side posts by the use of a small



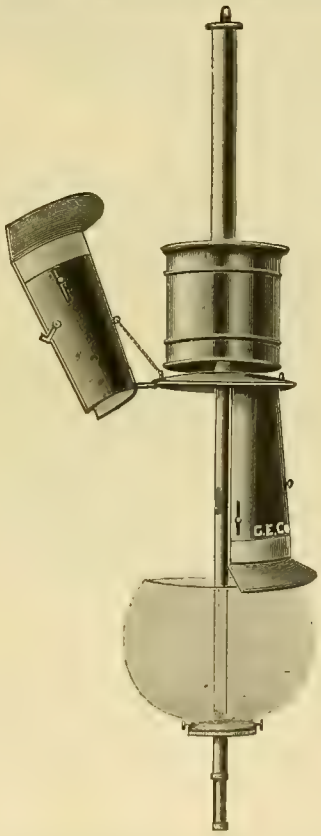
SMITH STREET LAMP HOOD.

iron rod. The device is introduced by the Electrical Supply company of Chicago.

The Robertson Carbon Protector.

The cut shows an ingenious device for protecting carbons and carbon rods from the effects of sleet and snow. The protector is made of galvanized sheet iron and japanned, and is strong enough to withstand a great deal of hard usage.

At the bottom is an extension feature that permits the adjustment of the protector to almost any size of lamp. The cut shows one side thrown up to allow the trimmer to give the lamp necessary attention. The lower flange is also shown partly extended. Several hundred of these protectors which have been in use in Minneapolis for some time, it is said, have given



ROBERTSON CARBON PROTECTOR.

perfect satisfaction. The device can also be used as a spark arrester. The Central Electric company of Chicago is introducing the protector.

Litigation over Electric Poles in Chicago.

The Chicago city law department has instituted proceedings against the Hyde Park Telegraph & Electric Light company to compel the latter to remove the poles and wires recently put up. It will be remembered that the company secured a franchise from the Hyde Park trustees before annexation. In November it applied to the commissioner of public works for a permit to erect poles in Hyde Park, and permission was refused until what purported to be a copy of the ordinance was placed in the hands of the commissioner. This, on its face, gave the company the right to use the streets, and the permit was issued. The company immediately put a large force of men to work and erected forty miles of line or about 1,000 poles on the main streets and avenues. It was then discovered, it is alleged, that the copy of the ordinance submitted to the commissioner had been altered and the material words, "with the consent of the property owners" eliminated. When the city attempted to stop the work the company secured an injunction, put on more men and finished the work. The city now seeks to have the poles removed by order of the court.

Trolley Wire Tighteners.

The cuts illustrate devices for taking up slack in overhead electrical conductors. These fixtures were designed by David Mason of New

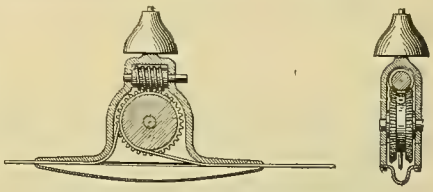


FIG. 1. TROLLEY WIRE TIGHTENER.

York, and are intended more particularly for service on electric railways employing overhead conductors. In Fig. 1 a small drum is mounted on a pin set in the case or cover for the device at right angles to the length of the trolley wire. The wire is carried around the barrel and is held in place by a pin set in the periphery of the drum, around which the loop of the wire passes. Each end of the drum is provided with a beveled cog, which meshes with a horizontally disposed worm. The shaft of the worm is extended to the outside of the casing, where it is formed with an angular head to receive a key. By means of this key the worm may be turned in a direction either to wind or unwind the wire.

Fig. 2 is a device designed to be used for the same purpose as the one just described.

In this tightener the trolley wires are attached to the ends of two protected arms. A bolt and spring arranged as shown at the upper ends of arms furnish means of adjustment.

Electrical Fire Kindler.

A device for lighting a fire and operating an alarm gong has recently been constructed

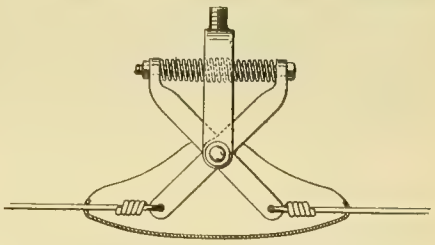


FIG. 2. TROLLEY WIRE TIGHTENER.

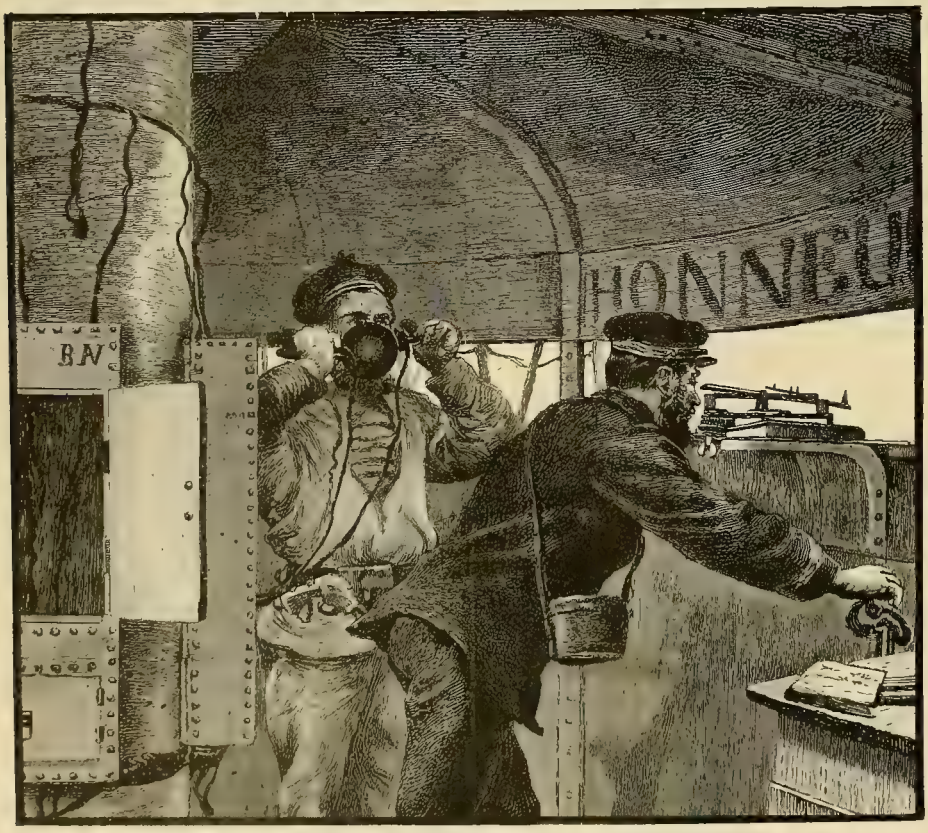
by A. B. Cross of Concord, N. H. While the fire kindler is not strictly speaking a novelty, it is said to work quite efficiently. Mr. Cross writes that in operating his device he employs two cells of open circuit battery which have an e. m. f. of about one volt each. This battery feeds two electric bells, the alarm clock and the fire kindler. The clock closes the circuit at any hour at which it is set and strikes both bells till the fire is burning. The kindlers are made as follows: A notch is made in a small piece of wood and in this a few grains of powder are laid. A short piece of small fuse wire about one-half inch long is laid in the notch, and is attached to the circuit by a small tack at each end. A small wad of oily waste, paper or other inflammable substance is placed on the wire or wrapped around it. Care is taken in selecting the fuse wire not to have it too large, for the current. One and one-half ampere wire may be

used. A light bare copper wire is run from the fuse to the current wire just outside of the stove. Five inches of copper wire and one-half inch of fuse wire are burned to make one fire.

Telephone in Torpedo Work.

Perhaps the most interesting part of the equipment of a modern warship is its torpedo boat apparatus. To the perfection of these destructive little craft naval experts are giving the closest attention. In their management no little electrical apparatus is used. An interesting application of the telephone in connection with torpedo work is represented in the cut.

The illustration represents a scene on a French warship, where the officer in charge directs from his station the launching and aiming of the torpedo. An attendant by the side of the officer has attached to his ears a telephone which keeps him in communication with the men who are manipulating the launching tube through which the missile slides from the vessel on its journey of destruction. The movements of the tube are indicated by an instrument which the officer has before him. He can obtain through the sights the precise direction which he wishes the torpedo to take, and by communicating through the telephone to the men in charge of the torpedo he can direct the tube in the proper position. At the moment that the tube is properly pointed simple pressure on a button causes it to start on its journey toward the object which it is launched to destroy.



THE TELEPHONE IN TORPEDO WORK.

Legislation for the Military Telegraphing Corps.

The House of Representatives last week passed a bill for the relief of telegraph operators who served in the war of the rebellion, in which "the secretary of war is authorized and requested to prepare a roll of all persons who served in the operation of military telegraph lines during the late civil war, and to issue to each, upon application, unless it appears that his service was not creditably performed, or to the representatives of those who are dead, suitable certificates of honorable service in the military telegraph corps with the army or navy of the United States, stating the service rendered, the length of such service, the dates, as near as may be, between which such service was performed, and the assimilated rank, if any they held by general or special orders of the commanding officers under whom they served, provided, that this act shall not be construed to entitle any person who served in such military telegraph corps to any pay or allowances to which he was not previously entitled, nor to entitle him to recognition as an integral part of the army or navy of the United States during such civil war."

This question has been under consideration for a long time and Congress has repeatedly been petitioned to acknowledge the services of the telegraph corps. This is the first time this contingent of the army has received any recognition. The members of the telegraph corps are not satisfied with this measure, however, and they will endeavor to have it amended in the Senate, eliminating the last two lines by which they are denied recognition as an integral part of the army and navy.

Salt on Street Railway Tracks.

The use of salt on the tracks of street railways operated by electricity is opposed by the owners of fast horses and draymen. The companies claim that it is necessary to use salt to keep the tracks clear of snow and ice; otherwise they would be unable at times to operate their cars in winter and put the public to the inconvenience of serious delays.

The opponents of the present method of clearing the tracks have succeeded in securing the opinion of two prominent medical authorities, to the effect that the mixture of salt and snow is not only a nuisance, but injurious to the health of the people. It is alleged that the breathing of the air charged with the exhalations from the combination predisposes the human system to attacks of pneumonia. The subject will undoubtedly receive careful attention, as it is one of great interest to electric companies.

The World's Fair.

At the headquarters of the World's Fair commissioners, it is expected that Director General Davis will appoint the head of the electrical department within the next week. This department has not been organized as yet, and electrical engineers throughout the country and manufacturers of electrical apparatus are desirous of knowing what provision is to be made for their exhibits. The electrical fraternity generally is anxious to have the department organized and the work begun.

Fort Worth, Tex., capitalists have arranged to construct an electric railway at Prospect Heights.

Kensington & Knightsbridge Storage Battery Plant, London.

The Queens Terrace Mews storage battery station illustrated in the diagrammatic cuts is a branch of the Kensington station of the Kensington & Knightsbridge Electric Lighting company of London. It is distant from the latter main station about 800 yards. These distant batteries can be, if desired, charged in parallel with the home batteries, or they can be charged in the morning, and be discharged into the network when required. One of the advantages found by having more than one pair of batteries attached to the system, at points tolerably wide apart, is, that the effect of the regulating movement of switching in an extra cell, which would show a difference of two volts on the lamps, is partly neutralized by the distant battery. Consequently, if such a regulating movement is made at Kensington, instead of an alteration of two volts for the whole circuit, an alteration of only half a volt is perceptible; and when the regulation is also made at the distant point, another sudden change, not exceeding half a volt, is perceptible.

Figure 1 is a plan showing the position of the switchboard and cells. Figure 2 is a section at *A. B.*

The large doors shown at the right-hand end of the plan, Fig. 2, allow goods to be brought in, and the platform is arranged at such a height that cells can be easily taken out underneath it. Upstairs there are a couple of rooms, one used as an office and meter-room, and here a record is kept of the exact condition of each cell, forming an accurate history of the performance of each. The room above is used as a shop for repairing meters. Perfect quiet and freedom from the vibration of machinery is here obtained.

The system of supply adopted by the company may now be called a modified "three-wire system," in that only one dynamo working to 220 volts is used. The two outside conductors of the system are bridged by two batteries of accumulators arranged in series, the regulating cells being at the outside ends, and the third wire of the system proceeding from the middle point. The whole of the district is laid with the ordinary three-wire network, and feeders; the latter consisting of a pair of wires only, are laid from the switch-board in the generating station to the distribution points in the network. The advantages of this distribution consist in the introduction of regulating resistances into each feeder. The house connections under this system are made very simple. A hole is bored in the culvert directly underneath the cover of the surface-box, and a pair of highly insulated wires are passed through, the ends being bared, and simply clamped on to their respective conductors. This is always effected at one of the surface-boxes, of which one is opposite every other house, so that every separate house can always be connected with the surface-box. The mains leave the generating station by a subway in which a man can walk for some distance upright, and are then led into culverts, such as are shown in Figs. 3 and 4. They are built of various heights, according to the space available under the footways; in cases where there are no vaults, they are usually made 1ft. 6in. deep, but they can be cut down to 9in where necessary. If there is not sufficient room even for this, wrought iron pipes are laid. The width of the culvert depends upon the number of mains which are to be laid in it. The ground is first dug out, rather deeper than is required for the culvert, and a layer of concrete about a couple of inches thick is thrown in to form the bottom. A wood frame, the outside measurements of which are the inside dimensions of the culvert, is then fixed in, leaving about 6in. on each side to be filled in with concrete, and when one length is set the boards are taken out and the face of the concrete is rendered with cement, and in cases where the culvert passes over vaults the bottom and the sides for a height of 2in. up are coated with pitch, to prevent any small quantity of water which may find its way into the culvert from passing through to the vaults. The cover consists of York stone, 2 in. thick, laid on with cement.

The distance between the training boxes depends upon the straightness of the street, and upon the distance between side streets. It has been found that a length of 200 yards can be dealt with, provided it is a straight run. The distance between the supporting insulators depends upon the length of frontage of the houses and the depth of the culvert in the first place, because a box is placed between every alternate pair of houses to avoid the necessity of taking up the pavement to make house connections, and the insulators are always placed under these box covers in order to provide easy access for repairs, or for increasing the section of copper; and in the second place, if there is a deep culvert and no necessity for a number of house connections, such as when passing a large building, the insulators can be placed further apart without allowing the copper to come too near the bottom of the culvert in the center between the supports.

The mains are brought into each house from the boxes mentioned, and are led into a cast iron box containing the company's main cut-out, the house mains being brought into the other end of the box; the cables are protected where they enter the box by thick rubber washers, and the base of the main cut-out is made of specially glazed porcelain which carries the bolts and nuts which hold the cut-out itself; the latter is made of thin wire soldered into thick brass washers at each end in order to make certain of good contact.

On referring to Figs. 3 and 4, it will be seen that wooden cross-bars are let into the sides of the culvert; the bars are treated with creosote and support glass insulators, upon which rest the bare copper strips which form the conductors; these bars occur at about every 80 feet where house connections are not required, and over each is placed a cast iron cover to allow of inspection.

Alternating with the ordinary insulator boxes are straining-up boxes, in which the joint is made between two lengths of copper strip, and it is strained up so as to allow of only slight sag.

The copper strip used is 1in. wide by ¼in. thick. The

illustrations show the method adopted under sidewalks, those under the roadway are larger and different. The mode of connecting the iron pipes to culverts is shown in Figs. 3 and 4, and the cable is drawn in and connected to the strip by screws.

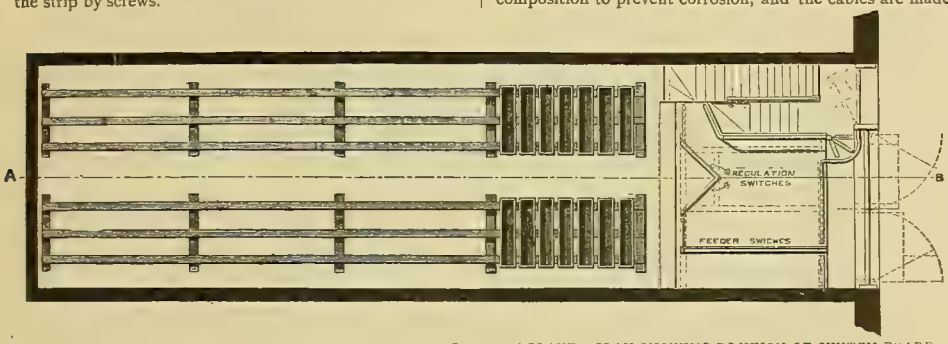


FIG. 1 KENSINGTON AND KNIGHTSBRIDGE STORAGE BATTERY PLANT—PLAN SHOWING POSITION OF SWITCH-BOARD AND CELLS.

The mains are laid down both sides of the street, and are of three sizes, according to the number of conductors. (1) Distributing mains, which form a complete network over the whole area; these are coupled at all points where any two lines cross, and in the case of long streets there are extra crossings laid down for the purpose of balancing the pressure; these distributing mains consist of three conductors, the sectional area of copper being in proportion to the work to be done in each section, and the third or middle conductor is half the size of the two outside ones. (2) Distributing mains and one pair of feeders. (3) Distributing mains and two pairs of feeders, or one pair of feeders and one pair of charging mains for distant batteries.

The construction is as follows: (1) A 15in. culvert, or three pipes at crossings, or five pipes in main runs. Three of these are for distributing mains, one for potential leads, and one spare for repairs. (2) A 20in. culvert or seven pipes, three of which are for distributing mains, two for feeders, and one for potential leads, and one spare for repairs. (3) A 24in. culvert or nine pipes, three for distributing, four for feeders, one for potential leads, and one spare for repairs. The wrought iron pipes are coated with composition to prevent corrosion, and the cables are made by Messrs. Henley's Telegraph Works, with vulcanized rubber insulation of high quality. In this case the pipes are laid in short lengths when passing houses, so that boxes can be fixed in the same manner as with the culverts, and to prevent the necessity for cutting pipes to make connections. The covers of the boxes are of cast iron, filled with concrete or asphalt.

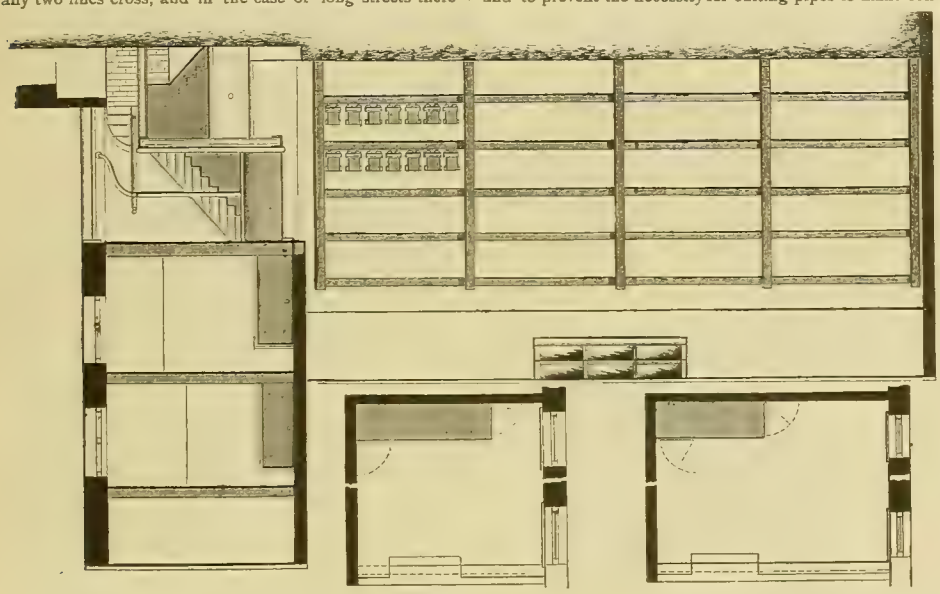
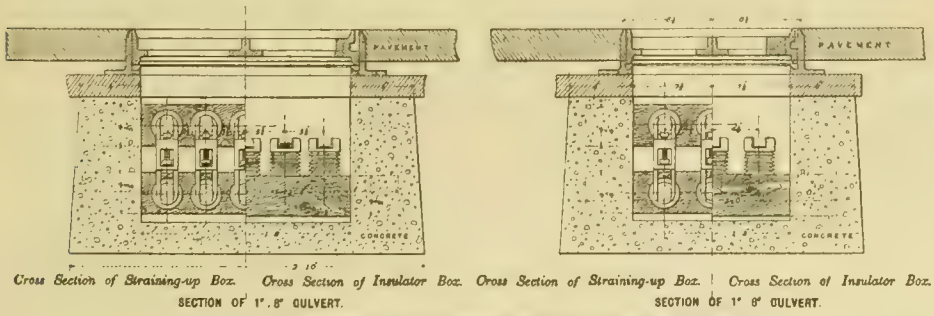


FIG. 2. KENSINGTON AND KNIGHTSBRIDGE STORAGE BATTERY PLANT

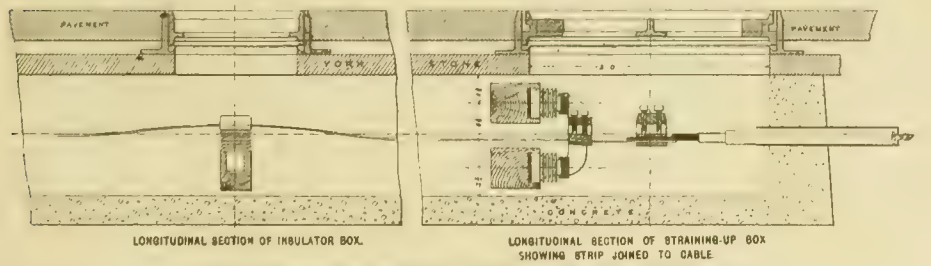
One of the house mains is cut at any convenient part of the circuit for the purpose of connecting the meter, which is mounted on insulators. The meters are tested and regulated in the stations before being sent out on the circuit, the Aron meters being timed for a week or ten days, as well as being tested with various currents, the latter being the only test required by the Chamberlain and Hookham meters. After being fixed in position the Aron meters are again tested for time, in case of any alteration having been made owing to the difference in position.



Cross Section of Straining-up Box. *Cross Section of Insulator Box.* *Cross Section of Straining-up Box.* *Cross Section of Insulator Box.*
SECTION OF 1'.8" CULVERT. SECTION OF 1' 8" CULVERT.

FIG. 3. KENSINGTON AND KNIGHTSBRIDGE STORAGE BATTERY PLANT.

The time kept by the two clocks is a matter which can be tested under ordinary working conditions so that should any error arise in this way it is soon found out, but so long as the meters are kept in good order, it is a matter of very rare occurrence to find even an error of three or four per cent.



LONGITUDINAL SECTION OF INSULATOR BOX. LONGITUDINAL SECTION OF STRAINING-UP BOX SHOWING STRIP JOINED TO CABLE

FIG. 4. KENSINGTON AND KNIGHTSBRIDGE STORAGE BATTERY PLANT.

The method of testing adopted after the meters are at work is to select a time when no current is required for one or two hours; the meter is then cut out of the circuit, nad is allowed to run, and note is taken not so much of the registration on the dial but of the position of the second hands at the side. In this way the number of swings of the pendulum which one clock gains or loses against the other in a given time can be arrived at, and any error set right. To show how exact a test can be made in this way, for example, when the meter is tested in the works a constant is obtained which shows the quantity of electricity represented by an advance per figure in the dial thus:

Advance registered $\times .096 = 1$ Board of Trade unit.

Which would represent about 15 oscillations of the pendulum. Meters are rented to customers prices ranging from $5 to $9, according to the size.

The company supplies electric light to 284 customers. There are connected to its two central stations and the battery station about 25,000 8 candle power lamps. The maintenance of the storage batteries, it is claimed, will not cost it over 8 or 9 per cent.

The current is charged for at the rate of 8 pence per Board of Trade unit (1000 watt-hours), and the cost of generation according to the contractors 2.02 pence, including coal, water, labor, stores and superintendence. This aggregate is for engine room charges only, and excludes salaries, wages in connection with distribution, management, office rent, general charges and renewals.

The cuts are reproduced from the London *Engineer*.

Storage Battery Traction.

More than the usual amount of interest was manifested in the meeting of the Wisconsin Electric club, Milwaukee, Jan. 8. A paper prepared by Prof. C. H. Haskins of New York, formerly of Milwaukee, on the storage battery traction, was read by Prof. A. J. Rogers. Prof. Haskins is apparently a firm believer in the future of the storage battery car. He thinks the accumulator will supplant all other means of operating street cars. Accumulator traction was, he said, now much cheaper than animal power, and he added that it was even more economical than the overhead electric systems, when the repair of wires was taken into consideration. In his paper Prof. Haskins spoke of the Main storage battery of the River & Rail company as follows:

"A new form of storage battery that I examined a short time ago, made on an entirely different plan, gives promise of great utility and durability. It is the invention of Prof. Main of Brooklyn. The main feature of the difference is in the manufacture of the lead plate. He puts between two thick lead plates, say twenty sheets of very thin lead foil, like sheets of paper. Each of these thin sheets is covered on both sides with fine plumbago. The thick sheets on the outside are like the covers of a book, of which the thin sheets are the leaves. The whole is then made solid by numerous lead rivets through the mass. The book is then punched, by a press, with numerous holes, entirely through. When this is done the plates are put into cells, and treated for weeks, until all the thin sheets are converted into active material. Of course the surface exposed to action is the circumference of these perforations. This forms the positive plate of the battery. The negative plate is a slab of amalgamated zinc, resting in a pan of copper, also amalgamated. The plates are horizontal, one above the other, in the jar. The chemical action is substantially the same as where two lead plates are used. This battery has been subjected to the roughest usage—so rough that any other form would be ruined—by vigorous charging and discharging. It is extremely active, and is coming rapidly into use for many purposes.

"For some years, experiments, costly and tedious, prevented the general introduction of storage batteries Then litigation followed, and until rights were determined, investors were chary. Now, however, that their economy and usefulness have been determined, and the patents settled, the business is going ahead rapidly I will add that the Julien company of New York, in response to inquiry, gave me a written proposition to maintain the batteries and motors on any cars furnished by that company at 5½ cents per car per mile run. These figures seem to settle the question of cost of maintenance."

On the latter point, however, Prof Haskins gave a number of examples showing that the storage battery is much cheaper, sometimes over 50 per cent., than horses. He also showed that the storage battery system was cheaper than steam or compressed air. He closed his paper as follows:

"In conclusion, I will refer to one difficulty that all electrical street roads, whether trolley or storage, have suffered from. When the car is stopped the motor under the car is stopped also, and the circuit is open. When the circuit is closed, to start the car, as the motor is at rest, and the resistance of its coils is very low—but a few ohms—the current is practically short-circuited through the motor. And this continues, for a few seconds, until a counter electromotive force is established in the motor, and the motor begins to perform work by moving the car. This action is a severe strain on the power source. And many efforts have been made to construct some form of gear that will enable the motor to be disconnected from the car, and continue rotating while the car is at rest. It is necessary, however, that the connection gear shall be thrown in and out without a jar or shock, or there will be danger of breakage. This has finally been accomplished, in a very unique way, by Prof. Main, the inventor of the improved storage battery that I have described. The clutching is accomplished by a modification of the old 'sun and planet' wheel motion. The car is stopped, leaving the motor running. To start the car one motion of a lever opens the circuit, the second lever throws the motor into gear, and the car starts and will run several yards from the inertia of the motor. As soon as the car moves, the current is thrown on again."

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W. A. KREIDLER, - - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - } Associate Editors.
J. B. O'HARA, - - - - - - - - - - }
F. L. PERRY, - - - - - - - - - - }
A. C. DURBOROW, JR., - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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IF all the improvements now in prospect in Chicago are carried out, that city will begin to claim the distinction of being the best lighted city in the country. The latest scheme is to light the railroads by electricity along the entire line of their right of way within the city limits. It is stated that already the Lake Shore and Rock Island roads have agreed to do this, and also that it will be but a matter of a few days when the other roads shall have fallen into line. To have the street crossings well lighted will be a most decided improvement, and will undoubtedly prevent many accidents.

AFTER years of agitation the Military Telegraph corps has secured the passage of a bill through the House of Representatives in which its services during the war of the rebellion are partially recognized, but the bill denies ti the right to be considered "an integral part" of the army or navy. The committee's report recites the fact that the members of the corps "were of unusual intelligence and showed themselves possessed of courageous spirit and indomitable pluck. No men who served with the army showed themselves possessed of these traits to a greater degree." Yet despite the fact that these men suffered all the hardships of war and were exposed to all its dangers, and in utter disregard of the valuable services rendered by them, the government denies them the only recognition which they desire, and that which they are justly entitled to.

IT was stated in a recent letter from Pittsburg, which appeared in the WESTERN ELECTRICIAN, that a movement was in progress in that city to form a national association composed of all workmen connected with electrical companies. We stated at the time that the developments of the last few months did not cause one to have much confidence in labor unions as ordinarily conducted. We suggested that an association of electrical workers might be the means of accomplishing no little good if properly organized, and intelligently managed. In this issue a Boston correspondent describes the workings of an association which has been formed in his city on practically the lines which we recommended. If the work is kept up to the standard mentioned by the writer, the organization ought to be the means of accomplishing much practical good for the members of the association, and as such should receive the cordial support of employers.

"THE Phenomena of Earth Currents" is the title of a paper which was read recently before the Buffalo Electrical society. The author, William Finn, treats his subject in a most interesting manner. He tells of a number of experiments which have been tried and points out the close connection observed to exist between the variations of earth currents and periods of high and low water. Various other theories are discussed and reference is made to that theory in which the earth is looked upon as a huge thermo-electric pile. While the earth currents are much too weak to be utilized in any telegraph apparatus at present employed, Mr. Finn believes them to be sufficiently powerful at times to interfere with the service. The average strength of the British earth current is said to be about one-tenth of a milliampere. In this country, he thinks, it is certainly not less than double this amount. A difference of potential of ten volts at opposite ends of a wire, he states, has also been observed. Mr. Finn's paper will be read with especial interest by telegraphers and telephone electricians.

THE paper on "Electric Railways," read by Theo. P. Bailey before the Chicago Electric club, has attracted considerable attention and in one instance has been severely commented upon. It is intimated in the *Street Railway Journal* that Mr. Bailey has not only exaggerated the possibilities in the line of future adoption of the electric motor to street railway work, but the veracity of several statements is questioned. Mr. Bailey's reply, an abstract from which is printed elsewhere, dismisses all doubt on the subject. He reiterates his statements as to the probability that several large cable companies are seriously considering the advisability of substituting electric systems, and shows that men who have given the subject of cable traction much thought have acknowledged the supremacy of electric traction. The *Street Railway Journal* mentions two roads which it says it does not believe an electric company would equip if it were to be held responsible for its economical operation. Mr. Bailey meets this statement squarely and, as an illustration of what may be done by electric traction, cites the case of the West End company of Boston. "I do not believe," he says, "there is a point on Broadway or Third avenue, in New York City, where a greater number of cars pass in a given time than at the corner of Winter and Tremont streets in Boston, where the electric system is employed on the West End road in that city." In this connection a statement which appears in the Minneapolis letter this week is pertinent. The company operating the street railway systems in the Twin Cities determined to equip its cars with electric motors, although it had already purchased considerable material for cable construction. The Minneapolis correspondent states that the company is selling this material for old iron, as it has found that there is absolutely no demand for cable apparatus.

MASSACHUSETTS, which has come to be considered the vineyard of Nationalism, has just administered a set-back to the followers of Bellamy. The mayor of Boston has been advocating municipal control of electric lights, street cars, etc., and many smaller towns throughout the state have been clamoring for similar changes. The Supreme court has just given a decision that towns in Massachusetts cannot own or operate electric light plants for their own use and the service of their inhabitants. The court says: "Such authority is not within any of the customary powers which towns from early times have exercised, and must be derived, if it exists, from the statutes relating to towns. We see no indications in the existing statutes that the legislature intended to make provision for the exercise of any such authority by the towns of the commonwealth." This effectually disposes of the matter, and it is well for the people of to-day that the law makers in the old Bay State were not imbued with communistic schemes such as those which seem to have taken possession of conservative Boston.

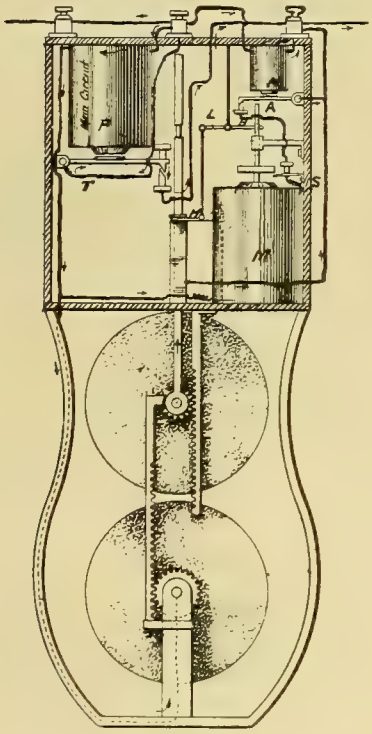
GOV. HILL in his last message to the New York legislature recommends the passage of a measure creating a state commission which shall include supervisory powers over gas, telegraph, electric lighting and telephone companies, similar to the jurisdiction conferred upon the board of railroad commissioners over the railroads of the state. The governor says: "The necessity for some such tribunal has been repeatedly demonstrated, but its establishment has thus far been defeated. Its creation, however, may be regarded as only a question of time." The experience of the New York electric companies with the Board of Electrical Control has not been such as to give them confidence in boards created and appointed through political agencies. The incompetence of the men appointed in the New York board has proved a great obstacle to the development of electrical industry in the metropolis. It would be a great relief to electric companies in New York to have some assurance that the selection of the members of the board would be made with the view of securing men of standing and ability rather than political bosses—in other words, men of scientific attainments rather than politicians, are wanted. Inasmuch as the selection of these men would be left with the governor or legislature there is little hope that the appointments would be made on the ground of fitness for the position.

TO outsiders the jealousy existing between the municipalities, St. Paul and Minneapolis, is getting to be somewhat of an absurdity. We are all familiar with the ridiculous fuss made over the census returns, and also how complaint was made that the force of laborers employed on the electric lines was being concentrated within the boundaries of one of the two cities in order to increase the grand total. The street railway company, operating in St. Paul and Minneapolis, is doing everything in its power to smooth over the jealousies of the quarrelsome twins. A correspondent writes from Minneapolis that the cars running on the interurban line carry on one side a sign reading "St. Paul and Minneapolis," and on the other side a sign reading "Minneapolis and St. Paul." At the end of each sign the words "Interurban Line" are painted. It is to be presumed that the Minneapolitans and the citizens of "the other town" will now consent to ride on the new system. It is to be hoped, though, that the railway company will be considerate enough to provide each car with two doors. In fact, it might be a good plan for the company to partition off the vehicles, or what would be better, run separate cars, one for each city. As a final suggestion we may add that it might be well to supply current to the system from both ends. Think of the feelings of a St. Paul man being propelled over the face of the earth by current from a Minneapolis station!

The Reppy Arc Lamp.

The lamp illustrated in the cut was designed with the view of producing a mechanism which would permit of continuous burning for a long time.

Referring to the cut, *M* is the arc-striking magnet and *N* is a small high resistance coil in shunt to the lamp. *P* is a magnet in the main circuit. The armature of the magnet *M* is carried on an upright rod which works in a dash-pot, and has an easy motion downward. This armature rod is slotted to receive the end of lever *L*, which connects as shown with lever *H*. This last mentioned part has a forked end upon which rests a lifting clamp of simple construction, designed to catch the rod when raised quickly. It will be thus seen that the energizing of the magnet *M* causes a quick lifting of the clamp and strikes the arc, while a slow feed results afterward. When the current is first switched on, the armature *A* is in contact at *B*, as shown, magnet *M* is energized, and the arc is struck. The descent of magnet *M's* armature pulls open the spring contact *S*. This action breaks the circuit through magnet *M*, and allows the slow feed to begin, and at the



REPPY ARC LAMP.

same time current is forced through magnet *N*, which breaks the contact at *B*.

When the resistance at the arc becomes less by the feeding of the carbons, the current through coil *N* becomes less, and its armature drops away again making its contact, and again sending a current through magnet *M* to lift the upper-carbon rod. It must be understood, however, that the spring *S* has in the meantime made contact, owing to the rise of *M's* armature.

To effect a complete cut-out of the lamp the main circuit is run to the carbons through a magnet *P*, the armature of which has a shunt-wire *T*, leading from its pivoted end to one side of the magnet. A contact under the free end of the armature is connected by wire *T* with the opposite side of the lamp. While the lamp is burning the magnet *P* is excited, thus holding the armature away from its contact. If there is no current through the carbons, there is none through magnet *P*, so the armature falls, and cuts out the lamp. Should, however, the carbons come together again, enough current would pass through magnet *P* to lift its armature and break the short circuit.

The arrangement of mechanism to revolve the carbon disks and maintain them in the proper relation one to the other, will be readily understood from the cut. This lamp is the invention of A. W. Reppy, Oakland Pier, Cal.

The Champion Battery.

The Champion primary cell is made up in two forms, but the glass jar and the carbon element are similar in both. The jar is made square. The carbon element consists of a quadrangular reservoir charged with a composition of manga-

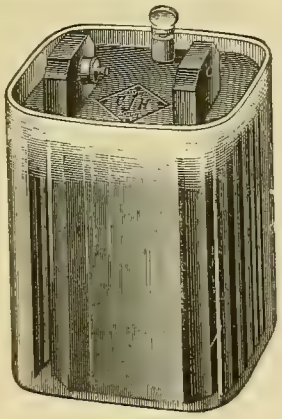


FIG. 1 CHAMPION BATTERY—CORRUGATED ZINC, COMPLETE CELL.

nese and other ingredients under a secret formula. Sal ammoniac is also employed. It is claimed that the composition used in the cell is such that the depolarizing influence is present to a degree which gives rema kable immediate results, as well as longevity and durability of

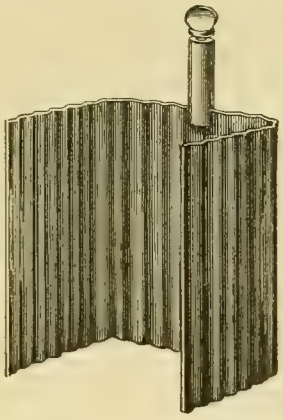


FIG. 2. CHAMPION BATTERY—CORRUGATED ZINC.

the battery. In one form there is employed the usual rod or pencil type of Leclanche zinc, differing from the ordinary pencil only in its increased diameter and the pattern of the connecting screw. This form is particularly suitable for telephone work. Another form is supplied with a large corrugated sheet zinc, which, it is stated, reduces the internal resistance of the cell to a very low degree. This type of cell was designed particularly for intermittent use where a large quantity of current is required for short

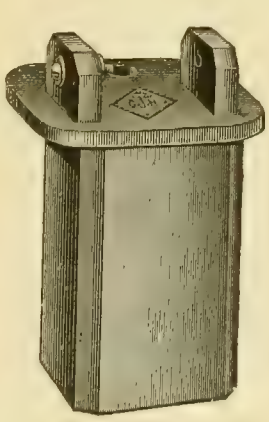


FIG 3. CHAMPION BATTERY—CARBON RESERVOIR AND COVER.

FIG. 4. ZINC ROD.

periods of time, as in gas lighting work, bell ringing, electric clocks, etc.

The cuts show the mechanical features of the cell. Fig. 1 gives the appearance of the battery when all the parts have been assembled and are in place. Fig. 2 represents the corrugated zinc electrode. Fig. 3 is the carbon reservoir and cover for the cell. Fig. 4 is the zinc electrode.

The inventor of the Champion battery is C. J. Hirliman of New York.

The Phenomena of Earth Currents.[1]

By William Finn.

The subject for your consideration to night is one that possesses considerable interest for the student of natural phenomena, and one that has engaged the earnest attention of scientists in general, and electricians in particular for many years past, especially in Europe

If you place a sensitive galvanometer in any well insulated telegraph line from which the regular battery has been withdrawn and ground the opposite ends of the wire, the chances are that you will find a current in the wire of sufficient strength to deflect the galvanometer needle. After repeating this experiment a number of times, you will probably conclude that the current is not a constant one, but on the contrary varies more or less in strength and sometimes in polarity also. The movements of the needle may be very sluggish at one time and play over but a few degrees of the scale, while at other times the needle may oscillate in the liveliest manner over a considerable portion of the scale on both sides of zero, showing great variations in the magnitude as well as in the direction of the current.

When you open the wire at either end these manifestations instantly cease, and do not reappear until the ground connection has been again established.

It will be evident from this that the effects observed do not proceed from induction, or stray currents from neighboring wires, either of which could tend to act more strongly upon the galvanometer on opening the wire at the distant end.

The effects observed are in reality caused by currents of natural electricity flowing from place to place over the surface of the earth, and which find their way into the telegraph circuits by means of the ground connections which form a part of every telegraph line.

These currents are not sufficiently strong as a rule to interfere with the ordinary working of telegraph lines, though I shall endeavor to show later on that there are times and conditions when they cannot but impair the efficiency of working.

The investigation at various periods by different observers into the cause of these currents has led to some very interesting and important scientific discoveries and deductions.

The apparently confused mass of data furnished by different observers on this subject, made it exceedingly difficult at first to derive any tangible results therefrom; but a careful analysis of the records has since shown that the earth current is not so erratic as might at first sight appear, but is on the contrary comparatively regular in its variations and amenable to law Here for instance is a plotted record of some observations taken at Valencia upon about 300 miles of the Atlantic cable which was lost in 1857. These early observations which extend over a period of 36 hours, were taken at short intervals apart, and the result as reproduced in the form of curves, affords a very fair idea of their regularity and periodicity. But the most important point was the close connection observed between the variations of the earth current on one hand, and the periods of high and low water marks on the other, as may be seen from the plotted current and tidal curves represented on the screen. In this was found a coincidence which at once suggested a clue to the possible cause of these mysterious earth currents, and the question at once arose, were the rising and falling waters of the ocean *directly* responsible for their appearance, or were the same causes which created the tides to be held accountable for the earth current phenomenon also?

The tides as you know are mainly due to the influence of the moon's attraction for the waters of the globe; the relative position of the earth and moon determining the times and places of high and low water. And very much in the same way it has been contended that the moon affects the distribution of the earth's electricity also, and creates electric tides or currents of electricity which flow over the earth's surface This appears quite plausible and agrees exactly with our knowledge of what would occur experimentally with two electrified spheres arranged to imitate the relative motions of the earth and moon.

This theory was apparently confirmed by the records obtained from subsequent observations, the result of one of which may be given. On a wire extending from London to Cardiff some years ago, a systematic course of observations was maintained every fifteen minutes for a month, and the curves of the figures so obtained were as remarkable for their regularity, as for the clearness with which they appeared to indicate the lunar origin of the variations.

On the other hand this theory was so incompatible with the results of many other observations, that recourse was taken to the consideration of the next question, viz: Did the undulations of the waters of the globe, by mechanical action or otherwise, produce those inequalities of potential at various points of the earth's surface which gave rise to the generation of electric currents?

The first consideration relative to friction was not favorably or seriously entertained; but it was thought highly probable that the moving mass of waters across the earth's magnetic lines of force might account for the phenomenon.

If you take an ordinary bar magnet and scatter iron filings over the surface of a piece of paper laid upon the magnet, the filings will arrange themselves in symmetrical curves extending from one pole to the other. These curves map out the lines of force of the magnet, and if a small freely suspended magnetized needle be brought near the magnet, it will set itself along these lines of force. Now the earth acts just like a magnet, and there is consequently

[1] Read before the Buffalo Electrical Society Jan. 5, 1891.

field of magnetic force extending from one magnetic pole of the earth to the other. A suitably suspended magnetic needle ought therefore to set itself in the direction of the terrestrial lines of force, and this point is very clearly illustrated by the inclination of this dipping needle. Their direction is such that were we to scatter a mass of iron filings in the atmosphere of this room, and cause the small particles to float like dust in the air, they would arrange themselves in a direction parallel to the dipping needle. Now, whenever a conductor moves across any of these lines of magnetic force, an electric current is set up in the conductor; and should the latter be moving very rapidly in an intense field of force the current generated may be very great indeed. An illustration of this is afforded by the dynamo machine, which is nothing more nor less than a combination of magnets and conductors so arranged that the rotation of the latter cuts the dense lines of magnetic force created by the former.

I have here an apparatus which will prove to you that the same principle holds equally good in the case of the terrestrial lines of force. The instrument is called a terrestrial induction coil, and consists essentially of a wooden ring six inches in diameter, upon the circumference of which has been wound an insulated wire measuring 320 ohms. This coil is made to rotate around a horizontal axis, and is placed in such a position with respect to the earth's magnetic lines that the greatest number of them will pass through the space bounded by the encircling wire. This position is obtained when the plane of the coil is at right angles to the direction assumed by the dipping needle.

If I now connect the ends of the coil with a sensitive galvanometer and make the coil revolve, the convolutions of the wire will move across or "cut" the earth's lines of force, which in this instance may be likened to a shower of rain falling at an angle of 72°. The result is that induced

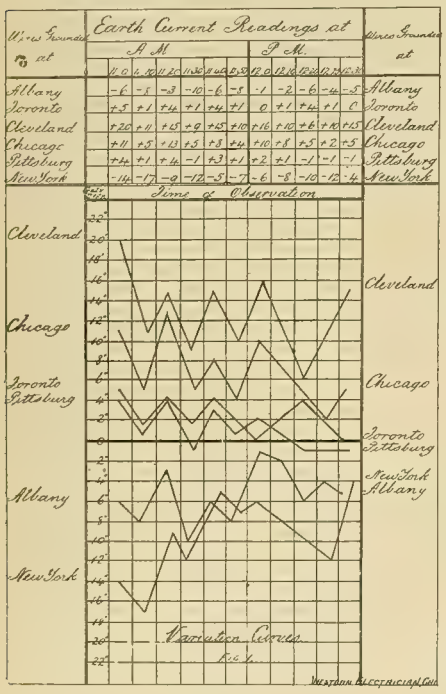


FIG. 1.

currents are generated in the coil, which as you notice produce marked deflections on the galvanometer.

You will readily see that the principle involved in this experiment is analagous to that which finds its application in the dynamo; inasmuch as the revolving coil of the inductive apparatus may be taken to represent an armature rotating in a portion of the field of force created by the north and south magnetic poles of the earth.

The manner in which the great tidal waves of the ocean in their movements to and fro affect this magnetic field, and how induced currents are thereby generated and circulated over the earth's surface, will now be more clearly understood.

It is not at all improbable that local currents may even be developed by rivers and running streams flowing over these imaginary lines of force, and some experiments made by the writer on wires running parallel with, and at right angles to, the Niagara river appear to demonstrate the correctness of this view.

Of the two theories under discussion the latter appears to be mostly in accordance with the result of observations taken by the writer both here and in England. There is considerable difference in the limits of the variations and strength of the earth current in this section of the country as compared with records of the same features in England. For instance the average strength of the British earth current is said to be about one-tenth of a milliampere, while here it is certainly not less than double that amount, and very often exceeds one and two milliamperes, and occasionally rises as high as four milliamperes, with a difference of potential at opposite ends of the wire in some cases, of nearly 10 volts.

My experience with earth current deflections in England was that it usually required a sensitive atatic needle upon which to take the readings. Here on the contrary they can be read on any wire at almost any time by inserting the 200 ohm coil of the tangent galvanometer.

This difference may be accounted for by the fact that the intensity of the magnetic field due to the earth's magnetism is not alike at the two places. For instance, the total force or "intensity" of terrestrial magnetism in Buffalo is about 0.6 dyne whereas in London it is about 0.4 dyne. In other words, an imaginary magnetic pole of unit strength in Buffalo, would be urged in the line of dip with a mechanical force of about two-tenths of a dyne unit greater than it would be in London.

Now, since the strength of an induced current depends —other things being equal—upon the *intensity* of the field of force, it follows that for the same amount of disturbance created in the respective fields of the two places, the stronger current would naturally be developed in the more intense field at Buffalo, which we find to be actually the case.

But even this hypothesis failed to satisfactorily account for all the vagaries exhibited by the earth current, and as a consequence other theories more or less plausible were invented, the least unsatisfactory of which is perhaps the following: It is a well known fact that a difference in temperature maintained at the opposite ends of a heterogeneous conductor will cause a steady current of electricity to flow through it. Take for example, a bar of copper and one of iron, and solder them together at one end, leaving their opposite ends free, and connect these free extremities with a galvanometer. If now the point of junction between the two bars be heated, a current will circulate through the system, and its strength will be proportional to the difference in temperature between the soldered and free ends of the conductors.

Now the earth is a huge heterogeneous conductor whose opposite sides are kept at unequal temperature by the heat of the sun, and it is quite within the range of probability that thermo-electric currents are established and maintained in the earth the same as in a thermo-electric pile.

The unsteadiness of the earth current, together with its variations in direction, do not however sufficiently harmonize with this theory to make it generally acceptable; though it is interesting to note that the circulation of thermo-electric currents around the earth, presents a very plausible basis upon which to account for the *magnetic* condition of the earth, and in *that* way these thermo currents may be the *indirect* means of producing the effects observed.

But from whatever source these currents of natural electricity flow, they are always to be found in the ground and ready to be tapped; and the question arises: Can they in any way be harnessed and utilized in the service of man as is now the case with the flow of natural gas? The currents are certainly far too weak and unreliable to be of any practical advantage in telegraphy with the style of apparatus at present employed; but as I stated at the outset, I believe they are sufficiently powerful at times to interfere with the regular working of that service. This opinion is based upon the result of numerous tests made of the value of working currents on certain telegraph lines passing through Buffalo. For instance, the actual value of some of the signaling currents taken on certain polar duplex circuits as well as on the polar sides of quadruplex systems, varies from eleven to thirteen milliamperes, which is not enough even under favorable circumstances to satisfactorily operate these systems, and for which as a rule a great deal more current is allowed. But the appearance of an opposing earth current in the wire under such conditions, would aggravate the case by an amount proportional to its strength, and might not only destroy the uniformity of signals, but render them altogether unintelligible.

I have taken readings from a distant battery whose reversals of polarity have indicated a difference in strength of from one to four milliamperes, when neither the state of the wire, nor condition of the apparatus appeared to warrant any such variation. On these occasions the wires have nearly always given evidence of strong disturbing forces emanating from the ground. Their influence can of course be counteracted by increasing the working strength of the battery, or by substituting wires of smaller resistance, either of which would increase the margin of the battery current beyond the variable limits of the earth current.

There are certain characteristics connected with earth current variations, which make the study of that phenomenon not only exceedingly interesting considered from a purely scientific standpoint, but which are also regarded as possessing features calculated to render them of considerable commercial importance.

It has been shown by certain investigators that when uninfluenced by outside interference, these currents ebb and flow over the surface of the globe like the tides of the ocean; and that the variations observed on any given wire, afford a sort of index to the variations which may be looked for on other wires. In illustration of this point I have mapped out the result of certain experiments made in London some years ago on a number of telegraph wires extending from that center to various points of the compass. The polarity and strength of the current on each wire were carefully and simultaneously noted once every hour for a certain length of time, and the readings thus obtained are reproduced in the form of curves. These show a remarkable coincidence in the rise and fall of the current in each line, and indicate beyond doubt that a wave of electricity was passing over that section of the country which affected all wires proportionately alike.

The curve demonstrations not only show its wave-like character, but also clearly define the course of the path taken by the current, which in the case under consideration was from a point N. E. to S. W., and happens to represent the prevailing direction of these currents in England.

One other significant fact noted during this particular series of observations was this: There were readings obtained from several other wires at the same time as the above, which did not harmonize either in strength or direction with those already given

A study however of the plotted curves made by these irregular currents, in conjunction with those mapped out by the more regular ones, plainly shows that the discrepancy in the agreement of the results is the outcome of some local disturbing force, the area over which it manifests itself being clearly discernible, as is also the length of time during which the disturbance lasted.

It will be evident from this then, that the study of the comparative results upon a number of wires around a given point, may lead to most interesting and instructive features having an important bearing perhaps on some of those natural phenomena affecting the condition of the globe or of certain localities upon its surface.

For example, the disturbance noted in the London records may have been occasioned by some convulsion more or less violent, or other internal forces at work below the earth's surface, due either to local strain—such as upheaval or contraction—or brought about by chemical changes, a knowledge of which might be of the utmost importance. In certain volcanic regions the discovery and study of these internal forces are materially assisted by means of telephonic and recording apparatus attached to buried wires which instantly convey the intelligence of any unusual commotion happening beneath.

During the course of several months' observations on various wires radiating from Buffalo, I have had many opportunities of noting exceptional fluctuations in the intensity and polarity of earth currents in this vicinity, and though I have been unable in the majority of cases to connect these with anything of a definite character, there have been times when the appearance of earth current disturbances has coincided with the occurrence of unusual solar or meteorological phenomena which fact would appear to establish a close identity between them.

From the result of other observations made here I am quite convinced that there remains little room for doubt as to the truth of the general law affecting the distribution and direction of the normal earth current.

I have selected from a number of such observations those recorded on wires extending to Toronto, Chicago, Cleveland, Pittsburg, New York and Albany on December 14, which will more clearly demonstrate this point.

The curves in Figs. 1 and 2, are plotted out from the simultaneous readings taken once every ten minutes for a

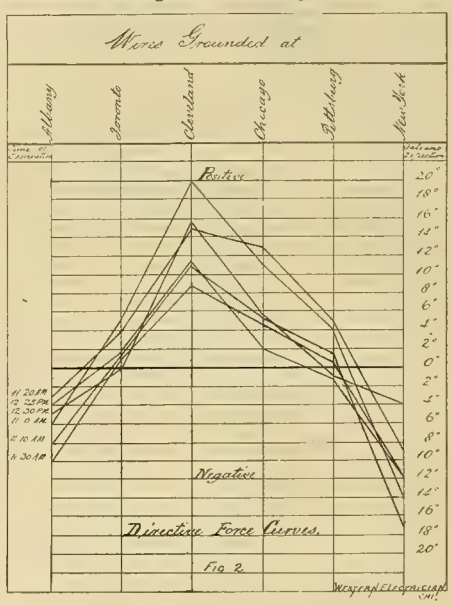


FIG. 2.

specified time on each of these wires, the result of each observation being noted down in the various columns, Fig. 1.

The coincidence apparent in the variation curves, Fig. 1, is sufficiently marked to indicate the undulatory character of the earth current over the sections tested at the time of observation. The slight discrepancy noted in the general coincidence at 12 o'clock and afterward, illustrates fairly well the occurrence of one of those slight irregularities to which reference has been previously made. The direction force curves, Fig. 2, which are obtained by reproducing the figures as read directly down each column, instead of from left to right as in the previous case, show the definite direction taken by the current. This direction is from Cleveland, which shows the most strongly positive reading, to New York, the most strongly negative point. The line of least intensity is that between Toronto and Pittsburg, or nearly North and South, which may be roughly considered as a direction at right angles to the easterly and westerly course of maximum current.

The telegraph wires of this country are too much occupied as a rule to admit of long and systematic records being made upon them, and hence it is somewhat difficult to ascertain with any degree of certainty the prevailing direction of earth currents in the United States, but from the evidence collected here the maximum intensity—in this section at least—appears to extend from a point N. W. to S. E. The daily records taken on wires between New York and Chicago show an almost invariable flow of the current from west to east, and it is on such wires as a rule that the maximum effects are obtained.

It occasionally happens that a wire grounded at some terminal office will exhibit totally opposite results as compared with those derived from intermediate points on the same wire. Thus, for example, on a wire grounded at Cleveland on Oct. 1, the earth current deflection was of an electro-positive character; that is to say, one whose polarity indicated that the direction traversed by the current was from Cleveland to Buffalo; but upon having the wire cut and grounded at Erie and Dunkirk respectively, these two sections of the wire presented an electro-negative ap-

pearance of about the same strength as the Cleveland current, and this anomaly existed in the wire for nearly five hours, after which the direction of the current coincided in all three cases. It thus appears that for some reason or other during the period named, Buffalo was at a lower electric potential relatively to Cleveland, but at a higher potential with respect to the intermediate points. though all these points may be considered as being in the same geographical straight line, and this singular result has appeared on subsequent occasions over the same route, as also on lines extending in other directions.

In fact the local records up to date may be said to be more remarkable for the amount of variation and unreliability displayed, than for the steadiness and regularity which as a rule appear to characterize the English earth current. It is possible, however that we have been experiencing the preliminary effects of those unusual electrical disturbances generally ascribed to sun spots, the advent of which is also more or less associated with the appearance of aurora, and the variations in the phenomenon of terrestrial magnetism. From reliable information I learn that during the months of October and November last, a number of solar disturbances were noted, the most extended and energetic of which occurred about the 17th and 18th of October, and 21st and 22d of November. On these dates the strength and irregularities exhibited by the earth current as shown by our records, are very much more marked than usual, and suggest a possible connection to say the least between these two sets of phenomena. It is however during the periods of maximum sun spots that the more violent fluctuations in the earth currents are felt. The effects observed on the wires at such times are of an entirely different character from those we have been discussing, and are usually classified in the category of magnetic or electric storm current effects. These electrical hurricanes come and go without any warning, and while they last are extremely irregular in direction, and of such enormous magnitude as to almost invariably upset the working apparatus. They also exert a direct influence upon delicately suspended magnetic needles without the aid of any conducting wire. The direction in which they flow is usually a straight line from one ground connection to the other, and not by the actual course taken by the wires; and they sometimes attain a current strength of 30 or 40 milliamperes which is more than is necessary to operate our duplex circuits, and almost powerful enough to maintain quadruplex working.

It is customary in the British telegraph service for the wire chiefs to note particularly the period and extent of these abnormal earth currents at all points where observations can be made without interfering with the regular service; and the data thus obtained is forwarded to London, where it is analyzed, plotted out when necessary, and the result made public before some of the scientific societies.

There are many difficulties in the way of securing records of this description in America owing principally to the "closed circuit" system in vogue here; but it would be possible on such occasions to take note at least of the circuits that are not affected by the disturbing forces, for the direction of such circuits would mark the course of the equipotential lines, which are always at right angles to the path taken by the disturbing elements Mr. Preece, the well-known English government electrician, who has made the subject of earth currents a favorite study for years past, has always entertained the idea that they are directly due to the action of the sun, which by induction brings about a variation in the distribution of the lines of potential on the earth's surface. It appears quite certain that there is a close relationship between the condition of the sun spot period on the one hand and these great temporary electric storms on the other, and all information obtained as the result of accurate and systematic observations on telegraph wires at times of unusual solar excitement, cannot but help to bring about important additions to our knowledge of the physical condition of the earth.

Electrical Unions.

Editor of the WESTERN ELECTRICIAN.

I noticed in a Pittsburg letter in your issue of Dec. 12, a statement that the electrical workers of that city intended to form a national organization of electrical workmen employed in this country. In your editorial you remarked such an "organization might doubtless be the means of accomplishing no little good; on the other hand it might prove to be a mighty power for evil. If it is intended to form some sort of an association which will afford employes an opportunity to meet, exchange views and secure suggestions on practical work, the organization might be useful and valuable."

Now that is just what we have done here in Massachusetts. We have formed an association chartered under the laws of Massachusetts Our charter declares that the society is organized "For the better education, mutual improvement and elevation, and maintenance of the rights of its members, and the recognition of all other business matters in which the association may be interested, the establishment of a place of social meeting and the establishment of subordinate branches or associations throughout the state of Massachusetts and if possible the United States."

Our name is "Massachusetts Electrical Engineers and Mechanics' Association," Our requirements for membership are, that the applicant shall be a citizen of the United States or declare his intention to become such, that he must be able to pass a fair examination by a board of three investigators, and that he must have been one year in the electrical business, and of good moral character. Our constitution distinctly states that this association will maintain the rights of its members, but in no case will it establish a rate of wages for any of its members, or will it under any circumstances inaugurate a strike. These are conditions thoroughly realized and supported by the members.

We have a meeting every Thursday evening for the purpose of business, such as the payment of bills, reporting of sick members, stating positions vacant, so a member out of employment may investigate and obtain employment, lectures on electrical matters, problems on blackboard, experiments with electrical instruments, and singing and telling stories after regular business. Now could anything be simpler or better?

We would like to hear from every city in the Union where electricity is used, to see if we cannot form branch associations, so that delegates may be chosen and sent to national conventions held once a year in different places and thus have opportunities to confer with each other for the purpose of elevating the employes. Those wishing to write to us for further information may address Eugene McCarthy, Jr., corresponding secretary, 3 Head Place, Boston, Mass. FRANK J. JOHNSON.

Boston, Jan. 5, 1891.

Prof. Hirsh's Alleged Discovery.

There has been considerable discussion during the last few months on the alleged discovery by Prof. Hirsh of Chicago, who claimed that he had a method of reducing aluminum, plating, etc., that would greatly decrease the expense. Several companies were formed, and conflicting opinions were entertained. At last charges of double dealing were made against the "Prof.," and it was claimed that the specimens of aluminum which he displayed were secured from the Pittsburg Reduction company. The "Prof." alleges that he will demonstrate the practicability of his system, and he flatly denies the assertion that the aluminum displayed by him was secured from Pittsburg.

Electricity vs. Cable.

In a recent number of the *Street Railway Journal*, the paper read by Theodore P. Bailey before the Chicago Electric Club on electric railways was commented upon, and exception taken to several statements. The following is an abstract from the editorial: 'No matter how much we may all wish that electricity might at once be adopted as the universal motive power for street railways we know from the very nature of the case that it cannot be done. Nearly every street railway line in operation or building presents a different problem for the engineers to solve. To a few the cable is best adapted, to others electricity, and to others horse power We do not believe that there is an electric company in the country that would undertake to equip with electricity such lines as Broadway and Third avenue, New York, or Pennsylvania avenue, Washington, if they were to manage the lines and be held responsible for their economical working for the next five years. However much any one may entertain the hope expressed in the paper named above, that horse, cable or steam power will be numbered with the events of the past and that electricity will claim supremacy, we do not believe that cable railway managers nor those contemplating the building of such systems are giving themselves very much concern over the possibilities of such an event."

Mr. Bailey replies in a communication in which he says: "When I stated that several railway companies which adopted the cable system before the possibilities of the electric system were fully appreciated or understood were now seriously considering the complete displacement of that system, and the substitution of electricity in its stead, I had indisputable evidence of the fact before me, and that evidence is still in my possession. It is a notable fact that electricity is now being used on many roads where, two or three years ago, it was contemplated the cable system should be used. In fact at that time nothing but the cable system was considered for these particular cases.

"It is also a fact that several cable railway companies have used electricity instead of cables in equipping extensions or new lines, and I have no doubt others will do likewise in the future The principal reason why there has not been a general movement in this direction is that the required franchises for overhead wires could not readily be obtained. Cable railway companies in four of our leading Western cities are now arranging to supplant their cable with the electric system, and I have no doubt that within one year the final arrangements and contracts will all be closed.

"Mr. Frank Van Vleck, of Los Angeles, recently read a paper before the American Society of Mechanical Engineers in which he said: 'The writer, although connected with the development of the cable system, cannot but conclude that the day of usefulness for the cable * * * * has forever gone, and that the electric road stands the champion in the field.'

"Mr. Thomas Lowry, at the last meeting of the American Street Railway association, said that he was so thoroughly convinced that electricity is the coming power for street railways that this was the last convention that would ever seriously consider horses for the operation of street railways.

"In contradistinction with your proposition or statement that no electric company would undertake to equip with electricity such lines as Broadway and Third avenue, New York, or Pennsylvania avenue, Washington, etc., I speak advisedly when I say that I know of at least one electric company who would be very glad of an opportunity to equip any one of the three roads mentioned with a guarantee that the percentage of operating expenses should be less with electricity than with any other known system of motive power for traction purposes. I am not certain but that there are at least four other companies who would willingly accept a similar contract.

"I do not believe there is a point on Broadway or Third avenue in New York City where a greater number of cars pass in a given time than at the corner of Winter and Tremont streets in Boston where the electric system is employed on the West End road in that city. No one has ever doubted or questioned the complete success of this electrical installation, and any one familiar with the situation there will concede that it operates under conditions of the most adverse character, and that such a combination of unfavorable circumstances affecting the operation of an electric road cannot be found in any street railway system in the United States."

Storage Battery Litigation.

Editor of the WESTERN ELECTRICIAN:

The daily papers of Dec. 28 contained an item from Cleveland, purporting to give the facts in Judge Brown's recent decision in the suit of the Electrical Accumulator company against the Brush Electric company, on the question of interference between the Faure and Brush storage battery patents, which makes it appear that the Brush company had won a victory and was entitled to a decree.

I have long been an admirer of the talents and skill of the manager of the Brush-Julien storage battery literary bureau, who, upon the termination of every skirmish or battle always takes the ground that victory has perched upon the banners of the conquered

First, it should be remembered that the Faure patent is the only storage battery patent which has so far been adjudicated in the United States Courts, where the plaintiff and defendant were really on opposite sides.

In March, 1889, Judge Coxe in the United States District Court for the Southern District of New York rendered a decision sustaining the Faure patent. The newspapers and the public were, however, informed that the Faure method, known as the "paint, paste or cement" method, was inefficient and had been abandoned by the Julien company. In June, 1889, however, the Julien company petitioned the court for a rehearing of the case, which was denied, Judge Coxe in his decision asking: "If it be true that Faure's batteries are inferior to or no better than others, the question naturally suggests itself why are not the defendants content to use the other batteries?"

The Julien company answered this conundrum by stating that they had just found a method, greatly superior to that of Faure, but Judge Lacombe in October, 1889, decided that all the various methods the Julien company had so far employed, infringed the Faure patent.

It was then announced that this decision was a great relief to the Julien company, as they knew exactly what they could do, and what they could not do, in the making of storage batteries; but all the same the experimental plant of cars installed by them on the Fourth avenue road in New York City was shut down until the summer of 1890, by which time they had evolved another modification of battery, which they said was unmistakably clear of the Faure patent.

Meanwhile, the suits instituted by the Electrical Accumulator company against the Brush company in the Ohio District to determine the respective standings of the Faure and Brush patents had, owing to dilatory proceedings instituted in great part by the defendants, progressed no farther than the preliminary pleadings, and the merits of the case have not been brought into question, and no testimony has been taken.

It is in this case, that Judge Brown has made an interlocutory decision, involving three questions of law and fact as follows:

The Accumulator company applied to the court for leave to dismiss the two interference suits, alleging that, owing to the construction placed upon the Faure patent by Judge Coxe there no longer remained any interference. In one of these cases, namely, the one in which the Faure patent was in interference with the Brush patent, 337,298, the court decided the motion in favor of the Accumulator company; in the other case, Judge Brown held that the question of the expiration of the Brush patent, by reason of the prior grant of the Italian patent, could not be decided until after full hearing, and hence sustained the demurrer of the Brush company to that portion of the Accumulator company's bill, leaving the case to proceed on its merits.

In the same case the Accumulator company filed a supplemental bill, setting up that since the disclaimer filed to the Faure patent, there was no longer any interference between the first claims of the Faure patent and the formerly interfering claims of the Brush patent. The Brush company filed a demurrer to that supplemental bill, on the ground that this question could not be tried in that case, and Judge Brown also decided this question in favor of the Accumulator company.

The facts are, therefore, that in the recent case three points have been decided, two in favor of the Accumulator company and one in favor of the Brush company, leaving the case still to be tried on its merits,

The Accumulator company claims, and its claims are based upon a long and wide experience in the business, that no form of storage battery so far made has proved or can prove successful, except that made by the Faure process where the active material is applied to the support plate in the form of a paint, paste or cement prior to immersion in the battery fluid, and that where, according to Judge Lacombe's construction of Brush's experiments, a perfectly dry powder is compacted upon the grid by a hydraulic pressure and no fluid added until the plate goes into use in the battery, the absorption of the fluid by the active material causes it to expand and to exhibit a tendency to disintegrate, such tendency being accelerated on the occasion of each succeeding charge and discharge. In other words, a battery so constructed is not durable, and breaks down when subjected to any but ordinary strain.

D. H. BATES.

New York, Jan. 5, 1891.

The Raleigh, N. C., Street Railway company will substitute electricity on its lines. The Edison system will be introduced.

CORRESPONDENCE.

New York Notes.

NEW YORK, Jan. 10.—There were several matters of interest to the electrical fraternity considered in official communications presented to the public this week. Gov. Hill in his message to the legislature, recommends the establishment of a board to have charge of such matters as electric and gas lighting throughout the State. The natural opposition to this proposition would be based upon the fact that the appointing power would be invested in the governor or legislature, and it is not to be expected that these officials would be able to rise above the political plane from which they dispense all favors and offices. This city has had all the experience it desires in political boards, such as that which is now engaged in mixing up matters pertaining to the subways. Rapid transit for this city is again brought prominently to the front. A new commission has been appointed for rapid transit, and it has had its first meeting at Steinway Hall It has been decided to hold a public meeting next Thursday, when the commissioners will listen to suggestions from any one respecting the location of the route, and also plans of construction. There is little doubt that the commissioners are already favorably inclined to an electric system, and electrical engineers should avail themselves of an opportunity of presenting the latest and most advanced ideas which the science is furnishing. The New York *Sun* suggests that the commission take such measures as to compel the elevated roads to furnish a better service for the present, after which "it will be time for it to turn its attention to the devising of a grand system of comprehensive rapid transit for both the New York of the present and the future." In regard to electric propulsion, the *Sun* says: "Another point in connection with the elevated system upon which recommendations of the Rapid Transit Commissioners would have great weight, would be the procuring of some enactment compelling the use of electricity upon the elevated railroads instead of steam power. The substitution of steamless, sparkless, smokeless and comparatively noiseless system of traction for the present locomotives, is thoroughly practicable and should not be much longer denied to the citizens of New York. The very nature of the structure makes it a matter of the greatest ease to apply the current without the slightest danger to life or property. That electricity is not already used on these roads, is in the present condition of electric science, nothing short of public reproach."

The question of overhead wires in this city is considered in the mayor's message as follows:

"The work of removing the poles and overhead wires has been continued without interruption during the past year, and in every instance in which the companies have contested the right of the municipal government to compel the removal of these poles and wires, the city has been successful. The Board of Electrical Control during the past year has constructed for the reception of telegraph and telephone conductors 178 miles of single duct in nine miles of street trench, making a total construction of telephone and telegraph subways of 697 miles of duct in 38 miles of street trench. There have been constructed 132 miles of duct in 39 miles of street trench for electric light conductors, making for electric light service constructed up to date 647 miles of duct in 85 miles of street trench. There have been placed in the subways 10,150 miles of telephone and telegraph wire and 340 miles of wire for electric light service, making in all now in the subways, telephone, telegraph, and electric light wires, 23 797 miles. There have been removed during the year 1,361 poles and 18 949,645 feet of overhead wire. At the present time many of the departments operate a separate system of electric wires, which are largely maintained through separate cables. In several of the large cities of the United States a central electrical exchange through which intercourse can be had between the different departments of the city government, is in existence, under the control of the local authorities. It is a question for serious consideration whether such a system should not be adopted in this city. If it should be ultimately concluded to adopt such system it could be extended to enable the city to furnish its own electric lights."

Electrical execution complications are growing rather than diminishing, and it looks as if the fates had contrived to bring up some new argument each time to keep the horrible experiment from being tried again. Both Wood and Jugiro have been granted stays, and it may be a year before the matter can be finally settled. Deputy Attorney-General Hogan, in commenting upon the appeal, said:

"It is just what was expected after the decision in the Wood case. That gave any lawyer the right to appeal to the United States courts, no matter how frivolous the nature of his appeal, and then, when it was denied, to appeal again to the United States Supreme Court. But people make a mistake when they think that the electrical execution law alone is defeated by these appeals. The United States statute which has caused this trouble, covers every State. Any criminal condemned to be hanged in any other State can take his case to the United States Supreme Court. Practically, capital punishment is abolished in every State of the Union by that statute. Until it is repealed, as it should be at once, murderers all over the United States can stay their executions."

Leo Daft has brought suit against the United Electric Traction company for $50,000, which is claimed by him as a consideration in the formation of the new company upon the old Daft Electric Light company.

A great strike is in progress at the Edison Building in Broad street, and 300 mechanics refuse to resume work. The cause of the trouble is that Volkening & Co., non-union marble dealers are doing work on the Edison Building.

Judge William L. Muller, president of the Crosby Electric company, died suddenly of pneumonia last Monday. Judge Muller took a very active interest in electricity and brought the Crosby company to its present strong position. He interested with himself several of the best known men in New York, and it is deeply regretted that he has been cut off and the electric business has lost so prominent an exploiter. Judge Muller was the son of the well-known founder of the auction firm of Adrian H. Muller & Co., and was born in this city in 1841. He studied law in the office of John Murdoch, the district attorney of Chemung county, and in June, 1863, when Mr. Muller had just reached his majority, he was admitted to the bar at Binghamton. Mr. Muller began practice in Elmira In 1870 he was elected Recorder of Elmira, and on the expiration of his term of three years was re elected. Gov. Hill and Judge Muller had been close friends socially and politically for several years before they formed a law partnership in Elmira after Recorder Muller's second term had expired. Their partnership continued up to the time of Gov. Hill's election in 1885. At the next meeting of the Legislature Gov. Hill sent in to the Senate William L. Muller's name for Judge of the Court of Claims

A number of representatives of electrical papers gathered at Martinelli's last evening in honor of W. T. Hunt, who has identified himself with the *Electric Age*. Among those in attendance were: Clarence E. Stump of the *Street Railway Journal*, Jos. Wetzler, T. C. Martin and F. R. Colvin of the *Electrical Engineer*, George Worthington, Charles W. Price, *Electrical Review*, C Mc L. Paine, WESTERN ELECTRICIAN, J. B. Taltavall, T. R. Taltavall, R. J. Gray and W. T. Hunt, *Electric Age*.

The first meeting of the Electric Club for the year, will be held Thursday evening, Jan. 22d. At the last meeting amendments to the by-laws of the club were voted on favorably as follows: The classification of members was changed from resident and non-resident to active and associate, and the initiation fee of the former reduced from $50 to $40 and annual dues reduced from $50 to $40. The initiation fee of associate members was made $20, and the annual dues $20. The limit of membership in the club was raised to 1,000. A business meeting of the members to ratify the above action and to pass upon resolutions laid over from the last meeting, reducing the initiation fee one-half for a period of four months, will be held at 8 o'clock. A lecture will be given the same evening, due announcement of which will be more.

W. H. T.

Cleveland, O.

CLEVELAND Jan 9.—The Cincinnati Gas company has made the city an offer which embodies the agreement to furnish street light at one-half the cost of electric light, providing the latter is abolished. It also presents statements purporting to indicate that the arc lights in Paris have proved a failure and that gas has been resorted to; that even New York does not approve of electric lighting. The gas company seems to be backed up by a number of downtown property owners who, in their old, primitive way, anticipate disadvantages from the construction of underground conduits which are under consideration by the city board.

The proposed Euclid avenue extension from Erie to Huntington streets and on the latter up to Prospect street, has caused considerable commotion. The avenue millionaires object to the noise of the motors and do not wish their boulevard disfigured by iron poles. Said President Everett of the East Cleveland Railroad company: "It remains a question whether fifty millionaires of the avenue or 30,000 people of the East End are to be accommodated. Our corporation is now going to make a fight for the entire street from Erie to Case and take the matter to the legislature. We received our charter in 1882 under a steam railroad act, which had never been changed and had the power to appropriate a right of way in Euclid avenue."

The incandescent lamps of the Buckeye Electric company of this city receive a great deal of attention throughout the country, and the firm is just now contemplating an annex to its manufacturing plant.

The pure aluminum and aluminum bronze recently placed on the market by the Cleveland Aluminum company, a wealthy corporation especially organized for the manufacture of the new metal, has been adopted by several Cleveland and Eastern manufacturing machinists.

The electric elevators of the Elektron Manufacturing company are being exploited by the Cleveland Construction company. Ten have been placed so far; one will be installed in the new Y. M C. A. building here.

The Schlegel Electric company of Akron, O., has been incorporated with a capital stock of $10,000.

One of the Thomson-Houston search lights, such as are used on boats on the Mississippi river, is now exhibited in the local office. The light is 5,000-candle power and it is claimed that an object two feet wide and nine feet long can be seen by the aid of the light at a distance of four miles, if the atmosphere is clear. Business signs on Euclid avenue can be read very plainly from the Society for Savings building, where the lamp is exhibited. Manager W. R. Caulkins placed one on the steamer Progress last season, and will place at least a dozen more before spring opens.

A comparatively new electric company of this city has perfected a storage battery for which strong claims are made.

The Telephone company at Warren, O., will bring suit against the electric light company on the ground that its instruments are rendered useless after 6 P. M.

The Back river bridge of the electric railway at Martin's Ferry is completed.

The Mayfield Street Railroad company, composed of stockholders of the East Cleveland Railroad company, has been incorporated. The new line will start at the end of the East Cleveland road and run over Mayfield street.

The several extensions of the Hamilton, O., electric railway will be in operation by September next.

Representative Hodge has introduced a bill in the Ohio legislature providing that all cities may own street railway, gas or electric light plants, but if franchises are granted, they must be sold to the highest bidder.

W. W. Hazzard of this city reports that the South Covington & Cincinnati Electric road will be in operation tomorrow. The work was considerably delayed owing to an injunction restraining the company from erecting a pole in front of the Cincinnati government building. The work of extending the system through Newport and up to Dayton, Ky., will commence soon.

The South Covington & Cincinnati Electric company at a meeting Thursday, elected Thomas M. Jenkins, late assistant superintendent of the Albany electric road, as general manager of the entire system.

F. S. Oakes is in the city in the interest of the Salamanca (N. Y.,) Electric Railway company, and will probably negotiate for the equipment of the new road from Great Valley, N., Y., through Salamanca to West Salamanca.

R.

Denver, Colo.

DENVER, Colo., Jan. 8.—The last year was one of unusual activity in street railway building in Denver. No less than forty-nine miles of electric lines were completed and put in operation by five distinct companies. The University Park line was put in operation in March, and since that time work has been pushed in all directions. The building and equipment of the several lines are reported to have cost as follows: University Park, four miles, $65,000; East Colfax and East Capitol Hill, seven and one-half miles, $200.000; Lawrence street, five miles; Ashland and Agate avenues, two and one-half miles; South Broadway, five miles; Twenty-second avenue, two and one-half miles; Twenty-eighth street, two and one-half miles; South Fourteenth street, two and one half miles; West End electric, five miles; total mileage of electric roads for 1890, forty-nine; total cost, $835,000.

From present indications the construction for 1891 will equal if not surpass that of the past year. The Golden Electric line, thirteen miles in length, is being rapidly extended to the west and will be lighted the entire length. This is expected to cost fully $500,000. The East Colfax line will build a number of branches throughout the eastern suburbs, while ten miles of the City company's horse car lines will be converted into electric roads and in addition an electric belt line encircling the city is being strongly talked of.

At a meeting of the new management of the University Park Electric Railway company held Friday, the following officers were elected for the ensuing year: Frank Evans, president; John Musgrove, vice-president; W. G. Evans, secretary. Together with John C. Curtis and S. K. Durkin these gentlemen will constitute the board of directors.

The South Broadway Heights extension of the South Broadway electric, one mile in length, has been completed and was put in operation the first of the year.

The Denver Consolidated Electric company is putting in

350 new incandescent lamps for city service in the Third and Fifth wards.

The contract for the erection of an electric light plant in South Denver has been let for $13,000. The plant complete is expected to cost about $80,000. It is thought the town will be lighted by April 1. C. W. C.

Nashville, Tenn.

NASHVILLE, Jan 8.—The United Electric Railway company filed an amended charter last week with the view of extending its lines in the near future. The rapid increase of patronage appears to justify these extensions.

The four large open cars of this company, originally made to be used as trailers in summer, are being fitted with independent Westinghouse motors, and will be used in good weather winter or summer. These "excursion" cars will doubtless be immensely popular, as smoking, which is strictly prohibited on all others, will be allowed on the three rear seats.

The Citizens' Rapid Transit company began, on the 31st ult., to run cars regularly as far as the uncompleted bridge over the N. C. & St. L. railroad, a distance of two and one-quarter miles. The cars of this line are sixteen feet long, equipped with double motors and track brakes, are beautifully finished and upholstered, and the only ones in the city furnished with heating apparatus. So far the line works well, and is being well patronized.

The Nashville Railway & Power company has completed its car sheds and three-quarters of its track, and work is being pushed on the power house, which is located on the Nashville & Louisville railroad track between Cherry and Criddle streets. This line connects on Cedar and Cherry streets, in the heart of the city with all the other lines. The company expects to have the line in operation Feb. 1, next.

It is not uncommon to hear visitors from Chicago and other large cities compare Nashville's street car system with those of their own cities much to the advantage of the former, and whether they really mean what they say or not, it makes the average Nashvillian feel proud of his city.

Very little importance is attached to the rumor that the St. Louis Electric company intends to bring suit on the ground of infringement of the Adams' patents against all companies operating electric railways. Managers of the electric railways here say if it becomes necessary they are prepared to manufacture their own motors. Many improvements on all parts of electric railway systems, especially the trolley and method of putting up the wires, have been made in this city. B.

Milwaukee, Wis.

MILWAUKEE, Jan. 10.—All the Villard electric interests in Milwaukee have been consolidated, and Villard himself, is the president of the big company. The Milwaukee Street Railway company has been organized with a capital of $1,000,000, for the purpose of holding the Milwaukee City Railroad company, the Cream City Railway company, the Badger Illuminating company and the Edison Electric Light company. The officers and directors of the company are as follows: Henry Villard, president; Henry C. Payne, vice president; Charles L Colby, Colgate Hoyt and W. J. Curtis, all of New York; Frank G. Bigelow of Milwaukee, and David S. Wegg, Chicago. The Consolidated Street Railway companies will be under the management of Supt. Hommel, of the Milwaukee City. However, Supt. Linn of the Cream City, will not leave the service of the Villard syndicate. He will probably be placed at the head of an extensive suburban system owned by the company at Chicago.

An operating company, with Villard as president and Edward C. Wall as vice-president and manager, is being organized to control the electric light interests of the Villard syndicate. Mr. Wall states that the company will make a special business of furnishing electric power. Such power will be furnished to all who want it, and he predicts that it will not be long before electricity will be in general use here for power purposes.

The incorporation of the Milwaukee Street Railway company, was speedily followed by the filing of a mortgage for $10,000,000 to the Central Trust company of New York. The mortgage covers all of the Villard interests in Milwaukee. It provides that the mortgagor may issue from time to time, as it is deemed advisable, bonds within the sum of $10,000,000, and the Central Trust company is to place them. Only $5,000,000 of bonds are to be issued at the present time. The limit placed upon the same is in excess of the value of the Villard syndicate's Milwaukee property.

In the circuit court, Henry O. Parks has commenced proceedings to condemn the West Side Railway company's power house as a nuisance and to recover damages in the sum of $20,000. His residence adjoins the plant. He avers that the exhaust pipe throws a vile mixture of steam and grease upon his house, that the smokestack deposits soot all over his premises, and that the constant noise prevents his family from securing necessary rest.

Ever since the advent of electric street railways there has been more or less complaint about the telephone service. The proportion of underground telephone wires is quite small, but the work of burying them is going right along. In the meantime the trouble from induction continues to some extent. Secretary McLeod says that the only real remedy is a return metallic circuit. He adds, however, that for Milwaukee such a system would cost about $75,000, and the company would have to advance telephone rentals from 20 to 40 per cent. were a complete metallic circuit put in. The company, however, is putting in a "common" return wire. C.

Minneapolis, Minn.

MINNEAPOLIS, Jan. 10.—A change will be made in the transfer system now employed on Twin City electric lines within a short time. The company has been victimized by wholesale robberies under the present plan, and some scheme will be devised by which these can be stopped. Eight thousand transfers are issued daily by the agents of the company, many of which are fraudulently secured and some of which are wantonly given to parties in no sense entitled to them. Under the present plan this trouble cannot be prevented, as transfer agents are unable to tell among the throngs congregated at points of transfer just who among the applicants are entitled to checks. The scheme that will probably be adopted is the rebate. When the passenger wishes a rebate, he will be required to pay a nickel for it, which will be refunded upon the presentation of the check. Cheap fares and attractive service are doing much to increase street car travel The business of the interurban line continues to grow, and the company is now perfecting final arrangements for instituting a three-minute train service between the cities. Eighteen hours per day motors, each with a "trailer," will run each way every three minutes between Minneapolis and St. Paul. At present cars run every ten minutes, and the service is entirely inadequate for the demand upon it. The business of the interurban line is phenomenal, and it is believed that it will be more than doubled when the company is in position to furnish better accommodations. The rumor prevails that the company has recently rejected a very large amount for its franchise on this line, tendered by a syndicate of New York capitalists.

E. K. Tarbell of Winona, Minn., has closed a contract with the Edison company of Chicago, for the installation of a 600 incandescent light plant in the Hotel Winona at that place.

The Rhinelander (Wis.,) Electric Light company's plant will be increased within a few weeks by the addition of another engine and dynamo. A change in the situation of the plant is also contemplated, which will admit of the profitable use of sawmill waste for fuel.

The St Paul Street Railway company has put the electric loop line in practical operation in that city. The University avenue, Grand avenue, West Seventh street, Rice street and Concord street lines all use it, but for the present a few of the lines will not use it, among them being the Rice street extension and the Winnifred street line. Within a few weeks the Lafayette avenue line will be changed from horse to electric power. The new 1,200-horse power Corliss engine is now in operation in the Hill street power house of the company.

The last act in the history of Twin City cable construction is now in progress. One hundred thousand tons of iron which the company purchased a year or more ago to use in the construction of the First avenue line in this city, are being broken up and sold to local metal workers for recasting. Most of this iron will probably be used in the same manner, as there is said to be absolutely no demand for cable material. Besides this loss, in itself heavy, the company has a stretch of cable line half a mile long constructed from Bridge Square to Washington avenue, which will never be used.

The first of the new motor cars for the interurban line were put in operation yesterday. They carry motors of sufficient power to attain a speed of twenty-five miles an hour, and will reduce the time consumed in the trip between the cities from one hour to forty-five, and perhaps forty, minutes. They were built by the Laclede Car company of St. Louis, and are handsome and convenient as well as powerful. Each of them will draw a "trailer," thus giving to each train accommodations for about one hundred passengers, Within a few days the line will be fully equipped, and is expected to carry between 15,000 and 25,000 passengers daily. The street Railway company has deferred to interurban prejudice sufficiently to put a sign reading, "Minneapolis and St. Paul" on one side of each car, and one reading "St. Paul and Minneapolis" on the other; while at each end the words "Interurban Line" are painted.

E. L. Randall, who has attained some notoriety as a Brotherhood organizer among telegraphers, is still in Minneapolis, and some sort of an organization is maintained. Operators deny that it has any other than social purposes; but one of the local dailies claims to have information that it is the nucleus of a new organization now in process of formation among the operators of the country. Minneapolis is conspicuously a bad place for experiments of this nature, as the Western Union manager I. Michaels, so demonstrated a few months ago N. O. F.

THE ELECTRIC LIGHT.

The city plant at Little Rock, Ark., will be enlarged.

The Piedmont Construction & Land company of Seneca, S. C., will erect an electric light plant.

The Knoxville, Tenn., Schuyler Electric Light company has, it is stated, issued $20,000 of bonds for the purpose of enlarging its electric light plant.

The Electric Light, Heat & Power company of Farmville, Va., has been organized with C M. Walker, president, and J. M. Crute, secretary. The capital stock is $100 000.

The Bushnell (Ill) Electric company has been incorporated to furnish light, heat and power; capital stock, $75,000; incorporators, William M. Carpenter, Merritt B Austin and Frederick B Uhrig.

The isolated lighting department of the Thomson-Houston company, Chicago, has sold A Zeese & Co, 341 Dearborn street, Chicago, a special 18,000-candle power outfit, and the Schlitz Brewing company, for the Schlitz Hotel, Milwaukee, Wis., a 12-arc light plant.

The Edison Electric Illuminating company of Rochester, N. Y., is erecting a new power station to meet the growing demands for incandescent lighting. The company also reports a large demand for electric motors. It has made several large installations recently, one of 25-horse power to operate the press of the *Democrat and Chronicle*.

The Brush Electric Light company of Rochester, N.Y., has taken possession of its new offices in the Munger Building, South Water street. The store rooms and repair shops are also in this building, and a reading room has been fitted up for employes. It is the intention of the company to install an incandescent plant in the basement to supply light in the business district. The company is now supplying current for 1,500 arc lamps, and 600 motors from its central station at the lower falls. This station is operated by water power, and has already been illustrated in the WESTERN ELECTRICIAN.

THE ELECTRIC MOTOR.

An electric railway is being constructed by the Johnson City, Tenn., & Carnegie Street Railway company.

Several ordinances granting franchises to electric street railways in San Francisco were recently passed by the supervisors over the mayor's veto.

Electricity is being substituted for horses on the Central Electric Street Railway company's roads in Sacramento, Cal., and several carloads of machines and apparatus for the equipment of the lines has already been received.

The Kankakee Electric Railway company has been incorporated to build and run a street railway in the city of Kankakee, Ill., and in connection therewith operate a plant for the commercial distribution of light, heat and power.

It is reported that three electric roads are projected in San Francisco and will probably be built during the year. A large system is under construction in Oakland, another in Los Angeles and a short line in Sacramento. Another additional road will be put in operation in San Jose, and one is projected in San Diego. The outlook for electric road work in California is reported very good.

J. F. Burk, general manager of the Pacific Railway company, that operates the cable system in Los Angeles, says that company will begin changing from cable to electricity as soon as the legislature changes the section of the civil code that apparently prohibits electric roads in California The section will undoubtedly be amended at the next session of the legislature, according to an exchange. At the same time electric roads are now in operation in the state and more are building, so that the code is no real hindrance.

The enterprise of manufacturers of electric railway apparatus in this country is attracting attention across the water, and has called forth the following comment from a London contemporary: "The opportunities for American electrical engineers to ventilate their ideas are quite in keeping with the general progress of the science. Not only do our American friends institute a number of conventions, purely electrical in their aims, besides attending the usual and frequent meetings of electrical societies and clubs, but they are now thoroughly invading the conclaves of tramway men, who, by force of circumstances, are all becoming amateur electricians and staunch supporters of the new motor."

More than a score of gentlemen from Bridgeport, Conn , visited Rochester, N. Y., last week as the guests of the Rochester railway company. The stockholders of this company have recently added the Bridgeport lines to the

street railway systems under their control, and the trip to Rochester was planned to give the Connecticut gentlemen an opportunity of inspecting the new local electric railway. The party was met at the depot by a committee of Rochesterians and after lunch a general inspection of the electric railway system was made, including visits to the power house, the several car barns and the shops. A ride down Lake avenue to the Ridge road on the new cars was enjoyed, a stop being made at Driving Park avenue to give the guests an opportunity to see the lower falls and the high bridge. A banquet took place in the evening.

THE TELEGRAPH.

A dispatch from Brazil, Ind., says: The Postal Telegraph company, which has just completed a line from Indianapolis to St Louis is experiencing trouble in Clay county. The linemen were arrested for trespass, and suit is now pending in Clay circuit court. At a point five or six miles west of the city farmers, or others, persist in cutting down the poles. On Jan. 4, several for the second time, were cut down. Efforts are making to ascertain who the guilty persons are The question involved seems to be right of way. In 1820 the government built a military road, eighty feet wide from Cumberland, Md., to St. Louis, popularly known as the National road. The land through which it was built belonged to the government. In 1848 the road was ceded to the states through which it passed. Two years later Indiana sold her interest to Curtis Gilbert, and he in turn to others who hold certain rights. J. H. Blake of Terre Haute, owns this franchise through Vigo county, and the Postal Telegraph company had to move its line south to the old Bloomington road.

The consideration of the Postal Telegraph bill by the Post-Office House Committee was in order Friday, Jan. 9th, but it was not reported. A press dispatch from Washington says: "Judge Hayes, the Democratic member from Iowa, to-day prevented action in the Post-Office committee on the Postal-Telegraph bill. While no bill could be passed probably this session even a favorable report on Postmaster-General Wanamaker's plan for a limited government telegraph service would give an impetus to the proposition. The good offices of Gen. Bingham, the chairman of the committee, were exerted for months to keep the bill smothered. Now it has come to the point where the chairman has had to show his hand, and the burden of causing further delay has been taken up by Judge Hayes. At this stage of the session it is difficult to secure a quorum of a committee. The Post-Office committee managed to get a quorum Friday morning, but Judge Hayes insisted on taking up the time in various ways, and when noon was reached, at which hour the House assembles, he made the point that the committee must quit. It had to do so, and the Postal-Telegraph bill was not reported to-day."

Miscellaneous Notes.

It is announced that Austria will follow the example of America in the use of the electric counter in taking the next census.

The first number of *Amateur Electrician*, a monthly "journal for amateurs and beginners in the study of electricity," has just been issued at Ravenswood, Ill.

The Massachusetts Electrical Engineers & Mechanics Association of Boston, will give its first reception at Odd Fellows Hall, Boston, Jan. 29th. The hall will be tastefully decorated with Edison electric lights, no gas jets being used.

The Hoppes Manufacturing company of Springfield, O., has brought an interference suit before the commissioner of patents, against the Stilwell & Bierce Manufacturing company of Dayton, O. The suit relates to a patent on a method of connecting live steam feed water purifiers in such a manner that the air and gases will be circulated out of the purifier through the pump The Hoppes company claims to own the original patent on these connections granted to J. H. Berkshire, Feb. 19, 1884, and the patent in question is on a specific modification which the plaintiff alleges was invented by J. J Hoppes, president of the company.

Personal Mention.

A. H. Lewis, who has been connected with the Edison General Electric company at Chicago as special agent of the railway department, has resigned his position.

Business Mention.

William Hood of 239 La Salle street, Chicago, has secured the exclusive agency for the state of Illinois for the Walker electric meter.

Alexander, Barney & Chapin of New York report a flourishing business in Alexite, Herculite, Plasticon and the Fibrone products. These insulating materials must be in great favor, judging from the orders of a single day covering nearly every state in the Union.

The Interior Conduit & Insulation company of New York City was recently awarded the gold medal at the Mechanic's fair at Boston for its system At the recent test in Chicago excellent results were obtained, and Prof. Barrett and L. A. Bowden, superintendent of Harvey's Chicago Fire Underwriters, heartily indorse the system.

The firm of Hanson, Van Winkle & Co. of New York, has been reorganized as a corporation under the style of the Hanson & Van Winkle company. In the announcement the company says: "In our new corporation the members of the firm of Hanson, Van Winkle & Co., continue to fulfill the same functions as before, and the business will be continued with an increase of capital, enabling us to take advantage of the fluctuations of the market and all the modern improvements in manufacture."

George Cutter, who has been in the East for the past three weeks completing business arrangements, has returned to Chicago. He is now fitting up his shop for making the many electric appliances which he controls, and these will be put on the market very soon.

The business which has heretofore been conducted by Foree Bain, Chicago, will be continued by the Bain Electric Manufacturing company. The capital stock is $250,000 No new money has been put into the business and no new persons are represented in the company.

The Bassett combination portable and bracket, a new article lately introduced by the Electrical Supply company of Chicago, is having an unexpectedly large sale. It is durable and convenient, and can be used either as a bracket or as a portable. Owing to its simplicity of construction, it can be sold at a low price.

A number of handsome calendars for 1891 have been received at the WESTERN ELECTRICIAN office during the last ten days. Among the number are those bearing the names of the Anti-Friction Metal company, New York; the Holtzer-Cabot Electric company, Boston, and Pettengill, Andrews & Co., Boston, Central Electric Co. Chicago.

In a circular issued by the New York Belting and Packing company, 15 Park Row, New York City, the company says: "We have found it necessary to change the trademark of our Diamond grade of goods, and after the disposal of goods bearing the old trademark all *genuine* 'Diamond' grade of goods will bear the Double Diamond Brand. Our goods have been giving such great satisfaction that some manufacturers of rubber goods have found it profitable to use a Diamond brand in order to palm off an inferior quality Our 'Fine Para' and Carbon' brands will not be changed, as they are also secured."

The Detroit Electrical Works have in their shops fifteen Taylor trucks built by the Gilbert Car company of Troy, N. Y., which are to be equipped with Rae motors. The cars, which are of the vestibule style, are to be used on the electric railway at Aurora, Ill. The company is also equipping a Bemis truck with a Rae motor for the Joliet electric road. A Brill truck is being equipped for the East Reading road. A new 80,000 watt generator, which size and style is to be adopted as "standard" for the Rae system, has just been completed and is to be one of four to be made for a Galveston, Texas, road. The factory is being run to its full capacity, and the outlook for the coming season is most promising.

A Perret multipolar low speed 20 h. p. motor has just been placed in the Hamilton Club building, Brooklyn, to operate the pump of a hydraulic elevator, superseding a motor of another make. The company is now filling orders for motors for four different elevator builders. These low speed machines are rapidly coming into favor for the operation of elevators, some being connected direct to the screw shaft of passenger elevators, and some being belted to power elevators in the ordinary manner. They are giving great satisfaction, it is stated, under all these methods. The motors are now equipped, unless otherwise ordered, with self-oiling bearings and with self-feeding carbon brushes, which require practically no attention or adjustment.

The Triumph Compound Engine company of Cincinnati, O. has just issued a new catalogue. Speaking of recent improvements in the engine, which are matters of detail, the company says: "We have added an improved oil separator, which, placed inside of the crank case, separates the oil from the water and allows only the latter to escape. We have improved our pitman construction so that now *one* key takes up the wear in both boxes. Besides improving the details of the engine, we have increased our capacity and perfected our system of work. The difficulties incidental to all new enterprises have been entirely overcome, and we have shipped engines to Utah, Texas, Pennsylvania, Kentucky, Georgia, Florida and Alabama, besides points in our own state, and the new year finds our prospects bright with orders rapidly coming in, as we trust it will also find all our patrons."

The Manufacturers' Advertising Bureau & Press Agency, 111 Liberty street, New York City, has made quite a change in the appearance and appurtenances of its cosy quarters, which have been recently refurnished in a manner both attractive and noticeably convenient. This concern enjoys the pleasantest of business relations with all the representative trade journals both at home and abroad, and has the complete confidence of the many far seeing manufacturers who intrust their advertising department and newspaper work to it. Benj. R Western, treasurer and proprietor, has devoted many years to the science of profitable advertising, and the business which has passed through his hands since his advent in the advertising business is a strong recognition of his skill and ability in his chosen and unique field of labor. He has associated with him in the financial, editorial and other departments of his bureau, presided over by Joseph H. Williamson, business manager, a corps of workers, each well equipped for the duties which devolve upon him.

Queen & Co, Philadelphia, have just finished "taking stock" and are congratulating themselves that in spite of the general dullness in business during the past three months their sales have been greater than ever before, and the demand for their specialties is increasing month by month. Their standard resistance boxes, portable testing sets, ammeters and voltmeters, photometers, both portable and stationary, are of such a quality as to demand at least careful consideration, and large orders are received from all parts of the United States, as well as for export. In addition to manufacturing a full line of instruments of the regular types, they are continually engaged in designing new apparatus to meet the ever varied wants of the electrical engineer. In this connection should be mentioned the new testing laboratory which has just been added to the establishment. The room heretofore used for such purposes proving too small for the increasing work, a large, isolated apartment has been built, which will contain everything necessary for first-class work. Queen & Co.'s factory is probably one of the finest in America, devoted to the manufacture of scientific instruments. Skilled workmen are employed, and the lathes and other tools are the best and most complete. Close attention is given to making apparatus for special work after designs or specifications furnished, or they will design instruments to fulfill special requirements. With Prof. Anthony as consulting electrician in addition to the competent corps at their headquarters, they are certainly well prepared to handle their large and increasing business.

Electrical Patents.

Issued January 6, 1891.

443,991. Device for Exhibition Purposes. Sidney R. Ellis, New York, N. Y.

443,992. Manhole for Underground Electric Conduits. William H. Hart, Brooklyn, N. Y.

444,005. Tightening Device for Suspended Electric Conductors. David Mason, New York, N. Y.

444,006. Tightening Device for Suspended Electric Conductors. David Mason, New York, N. Y.

444,067. Dynamo Electric Machine. Alfred G. Holcombe, Long Island City, New York.

The invention consists in the combination of the ring, the central diaphragm, radial metallic strips connecting the diaphragm and ring, and stationary armature coils interposed between the ring and diaphragm.

444 104. Electric Arc Lamp. Albert W. Reppy, Oakland Pier, Cal.

444,108. Signaling Apparatus. Isaiah H. Farnham, Wellesley, Mass.

This invention concerns telephone circuits, and is an improvement in that class of such circuits wherein a number of stations are connected with the same main line

444,110. Brake for Electric Cars. Bellville L. Randall, Boston, Mass.

The improvements consist in such mechanism as will enable the driver of an electric car, when he applies the brake, to automatically and simultaneously cut off the power.

444,144. Signal Box. John C. Wilson, Boston, Mass.

444,154. Electric Arc Lamp. Joseph J. Skinner, Boston, Mass.

"Claim 5 The combination of the feed controlling magnet and its armature with a clamp pivotally connected at one point with the armature and an independent lever interposed between the armature and another point of the clamp, and a spring acting on said clamp in opposition to said lever."

444,169. Electric Motor Attachment for Reed Organs. Levi K. Fuller, Brattleboro, Vt.

444 188. Electric Motor. Charles J. Van Depoele, Lynn, Mass.

The invention comprises a closed circuited armature having a coil in inductive relation thereto, a field magnet and a single external source of current therefor, and coils in secondary relation to the coils of the field magnet and connected to the induction coil of the armature.

444,217. Electrical Range Finder. Bradley A. Fiske, U. S. Navy.

444,223. Magnetic Ore Separator. Clarence Q. Payne, Stamford, Conn.

The last claim reads as follows:

"8. The method of magnetically separating a mixture composed of magnetic and non-magnetic particles, which consists in passing the mixture through a magnetic field of the so-called 'unipolar' type, which acts on the magnetic particles and in which the non-magnetic particles are removed by centrifugal force."

444,245. Electric Annunciator. August Hormel, New York, N. Y.

444,265. Electric Agricultural System. Edward M. Bentley, New York, N. Y.

444,273. Swinging or Drop Arm for Electric Lamps. Edward Cliff, Castleton, N. Y.

444,277. Fire or Burglar Alarm. William Henry, Columbia, S. C.

444,284. Mechanical Movement. Albin Warth, Stapleton, N. Y.

444,285. Mechanical Movement. Albin Warth, Stapleton, N. Y.

444,286. Mechanical Movement. Albin Warth, Stapleton, N. Y.

444,317. Electric Wire Insulating Cleat. John S. Potter, Newton, and David J. Cartwright, Boston, Mass.

444,330. Support for Electric Lamps. James Chase, Rochester, N. Y.

444,358. Registering Mechanism or Counter Actuated by Electric Currents. Robert Jewell, London, England.

444,374. Electric Switch. Charles E. Wilson, Chicago, Ill.

444,377. Molding for Electric Wiring. George Cutter, Chicago, Ill.

444,392. Electrode for Secondary Batteries. Stanley C. C Currie, Philadelphia, Pa.

444 397. Current Collecting Device for Electric Railways. Rudolph M. Hunter, Philadelphia, Pa.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

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ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

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THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 29, 1886, he says: "**A Thoroughly Reliable and Desirable Wire in Every Respect.**"

The rubber used in insulating our wires and cables is specially chemically prepared, and **is guaranteed to be waterproof, and will not deteriorate, oxidize or crack**, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and to a very great extent, fire-proof. **Our insulation will prove durable when all others fail.** We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician.

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ALL SIZES AND QUALITIES

For Electrical Purposes.

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LONG LIFE, High Efficiency, **A CONSTANT** And Beautiful LIGHT.

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THE SUNBEAM INCANDESCENT LAMP CO., CHICAGO, ILL.

EMPIRE CHINA WORKS,

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HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

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The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE HARD PORCELAIN

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(LIMITED.)

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INSULATED WIRES and CABLES,

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—FOR—

AERIAL, SUBMARINE AND UNDERGROUND USE.

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SOLE MANUFACTURERS OF

CANDEE AERIAL WIRES. MANSON PROTECTING TAPE. OKONITE WATERPROOF TAPE.

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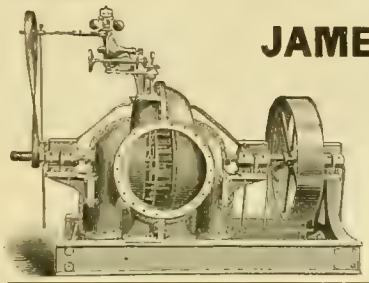

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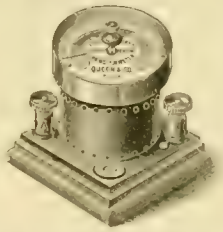

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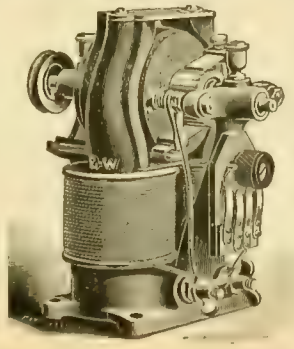

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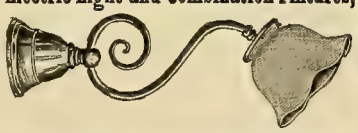

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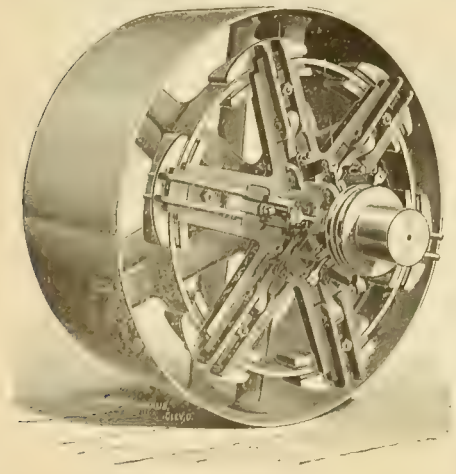

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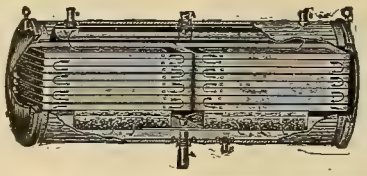

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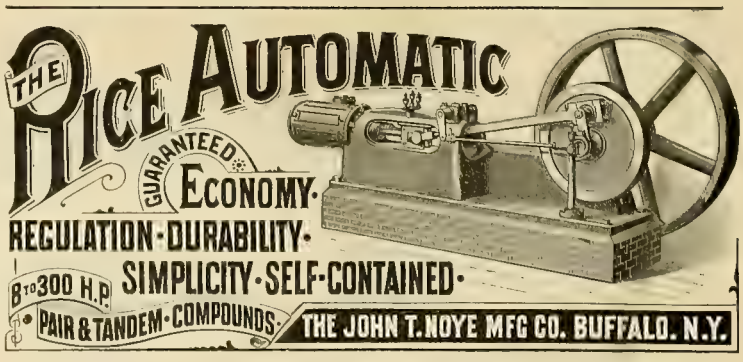

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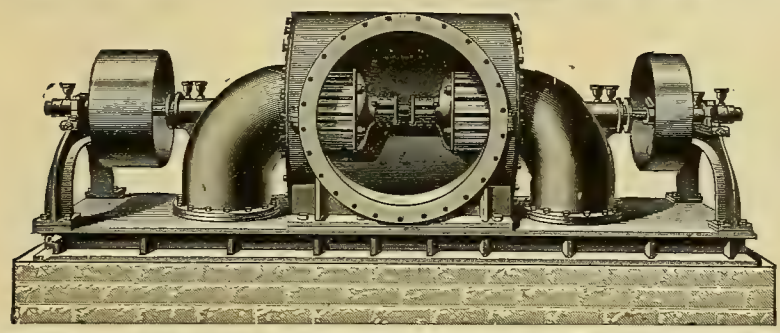

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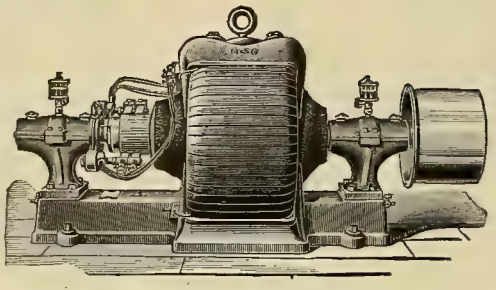

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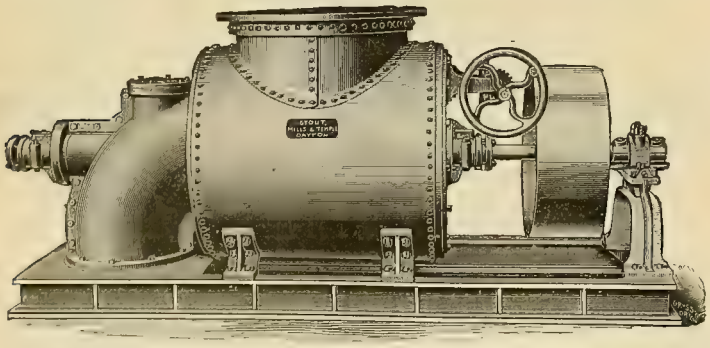

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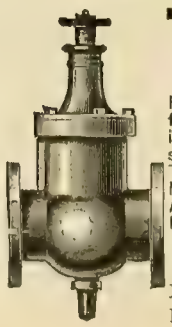

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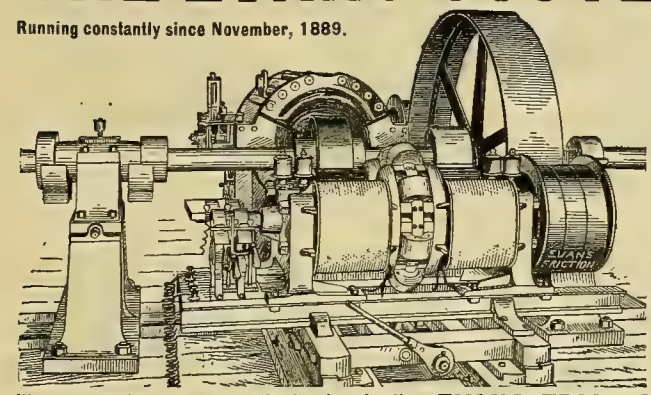

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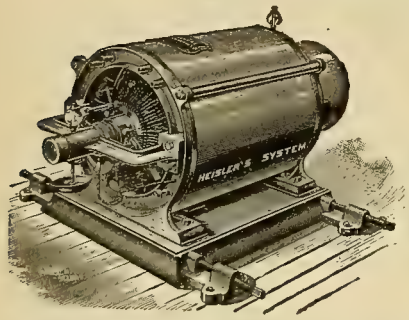

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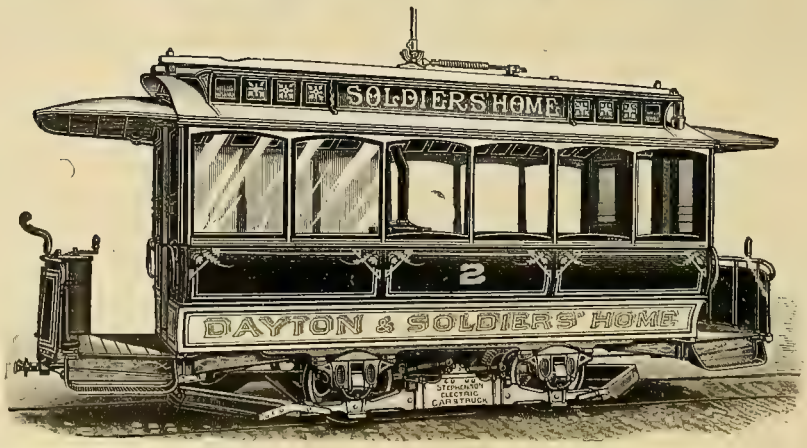

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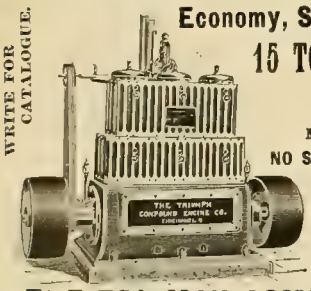

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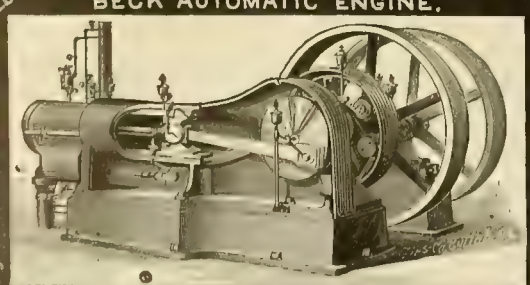

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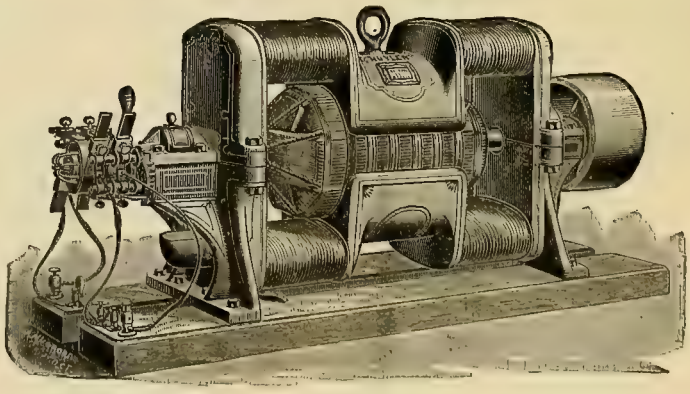

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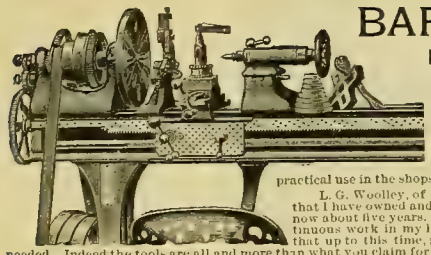

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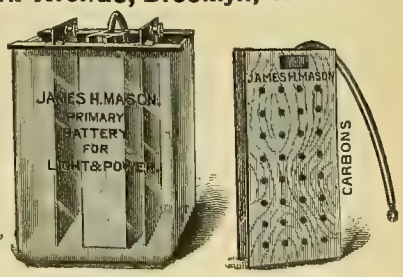

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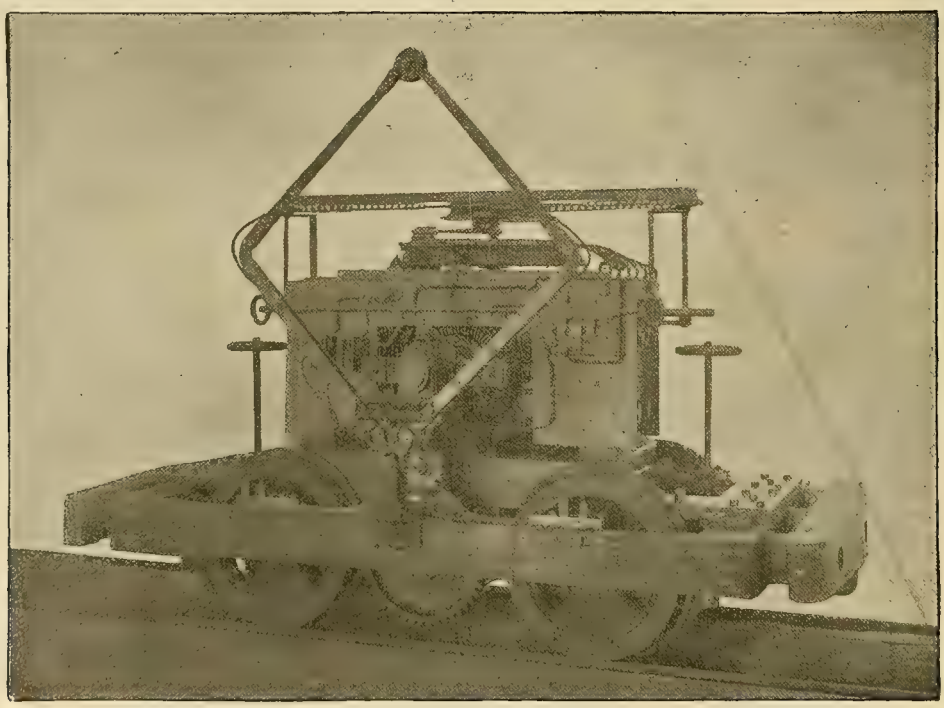

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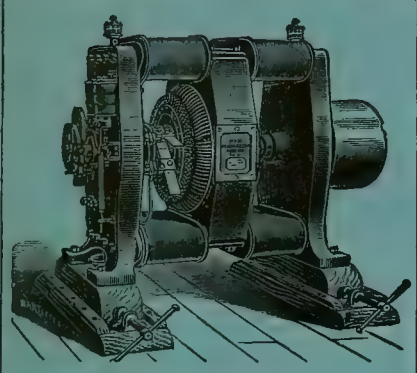

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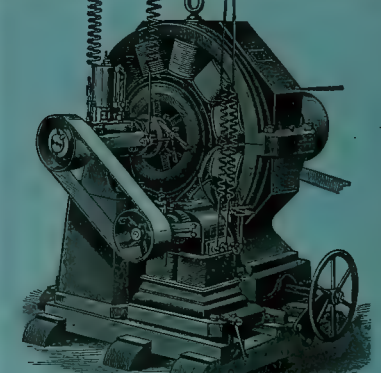

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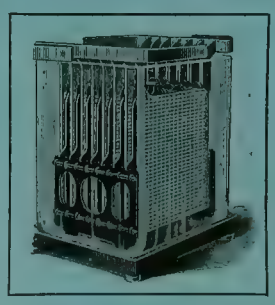

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New Hampshire, - -	15	10	$66\frac{2}{3}$ per cent.
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331 New York Life Building, Kansas City, Mo.
148 Michigan Avenue, Chicago, Ill.
405 Sibley Street, St. Paul, Minn.
215 West Fourth Street, Cincinnati, O.
1110 Noble Street, Philadelphia, Pa.
1333 F Street, Washington, D. C.
115 North 3d Street, St. Louis, Mo.

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Accumulators.
Accumulator Co., The.
Brush Electric Co.
Consolidated Electric Storage Co.

Aluminum.
Cowles Electric Smelting & Refining Co.
Cleveland Aluminum Co.

Annunciators.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
GreatWestern Electric Supply Co.
Greeley & Co. E. S.
Hay Mfg. Co. Wa ter.
Holtzer-Cabot Electric Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W R.,
Partrick & Carter Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Anti Friction Metal.
The Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Arc Lamps.
Bain, Foree.
Brush Electric Co.
Electric Construction & Supply Co
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
McLaughlin, Jas.
Northwest Thomson-Houston Elec. Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Bubier Mfg. Co.
Bunnell & Co., J. H.
Central Electric Co.
Crosby Electric Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
GreatWestern Electric Supply Co.
Jones Bros. Electric Co.
Law Telephone Co.
Leclanche Battery Co.
Mason, J. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stan ey & Hall.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Holtzer-Cabot Electric Co.
Partrick & Carter Co.
Queen & Co.
Stanley & Hall.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E S.
Hay Mfg. Co. Walter.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co.W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Wollensak, J. F.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., E. S.
Holtzer Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.
Standard Electrical Works.
Stanley & Hall.
Star Electrix Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.
Jewell Belting Co.
Mason, James H.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.

Books Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Jones Bros Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
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Cable Electric (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Stephenson Co., John.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain, Foree.
Electric Construction & Supply Co.
Chicago Electric Mfg. Co.
Knapp Electrical Works.
McLaughlin, Jas.
N. W. Thomson-Houston Elec. Co.
Shawhan Machine Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brush Electric Co.
Chicago Electric Mfg. Co.
Edison General Electric Co.
Hutton, Henry.
McLaughlin, Jas.
N. W. Thomson-Houston Elec. Co.
Pond Engineering Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.
Woodbridge & Turner.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Roebling's, Jno. A. Sons Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Monitor Electric Co.
N. W. Thomson-Houston Elec. Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Automatic Switch Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Illinois Electric Material Co.
Partrick & Carter Co.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Star Electrix Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain, Foree.
Card Electric Motor & Dynamo Co.
Colburn & Co., I. W.
Continental Dynamo Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Shawhan Machine Works.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Partrick & Carter Co.
Queen & Co.
Star Electrix Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner.

Electroliers and Combination Fixtures.
Baggot, E.
Bleckert & Nelson.
Electrical Supply Co , The.
Great Western Electric Supply Co.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Noye Mfg. Co., Jno. T.
Taylor Manufacturing Co.
Triumph Compound Engine Co.

Fire Alarms.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Cleverly Electrical Works.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.
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General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Cleverly Electrical Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
International Okonite Co., The.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Ostrander & Co.,W. R.
Partrick & Carter. Co.
Southern Electrical Supply Co.
Stanley & Hall.
Star Electrix Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Turner Brass Works.
Thomson-Houston Electric Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.
Wollensak, J. F.

Globes and Electrical Glassware.
Great Western Electric Supply Co.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Knapp Electrical Works.
Laminar Fibre Goods Co.
Monitor Electric Co.
Munsell & Co., Eugene.
Partrick & Carter Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Insulated Wires and Cables Magnet Wire.
American Electrical Works.
Central Electric Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Eureka Tempered Copper Co.
Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Buckeye Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Edison Lamp Co.
Edison General Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co. E. S
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Sawyer-Man Electric Co.

Lamps, Incandescent—Contd.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lathes and Machine Tools.
Barnes Co. W. F. & John.

Magnet Wire.
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Medical Batteries.
Fletcher & Fletcher Electric Co.
Partrick & Carter Co.

Mica.
Eug. Munsell & Co.

Mining Apparatus, Electric.
Bain, Foree.
Edison General Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Foree.
Brush Electric Co.
Baxter Electric Motor Co.
Card Electric Motor & Dynamo Co.
Connecticut Motor Co.
Crocker-Wheeler Motor Co.
C. & C. Electric Motor Co.
Detroit Electrical Works.
Edison General Electric Co.
Elektron Manufacturing Co.
Hawkeye Electric Mfg. Co.
Shawhan Machine Works.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
United E ctric Traction Co.
Westinghouse Electric & Mfg. Co.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Patent Solicitors.
Barton, Geo. P.

Pins and Brackets.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co
Illinois Electric Material Co.
Standard Electrical Works.
Southern Electrical Supply Co.
St Louis Electrical Supply Co.
Western Electric Co.

Poles.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Milliken & Co.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
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Speaking Tubes.
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Queen & Co.

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International Okonite Co. The.
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Western Electric Co.

Telephones, Electric.
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Western Electric Co.

Test Instruments.
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Central Electric Co.
Electrical Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Trucks, Electric Car.
Detroit Electrical Works Co.
Edison General Electric Co.
Peckham Street-Car Wheel&Axle Co
Stephenson Co , Jno.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co , James
Stilwell & Bierce Mfg. Co.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter Co.
Roebling's Sons, Jno. A. Co.
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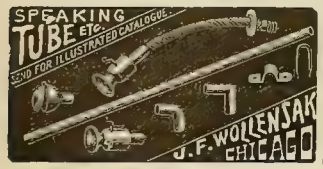

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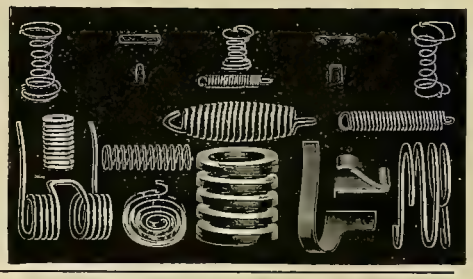

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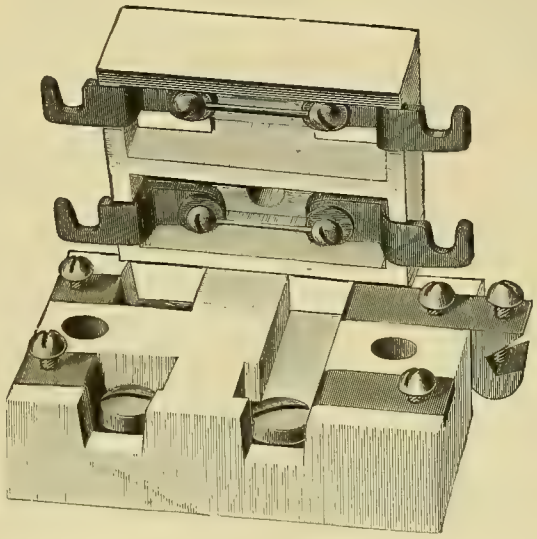

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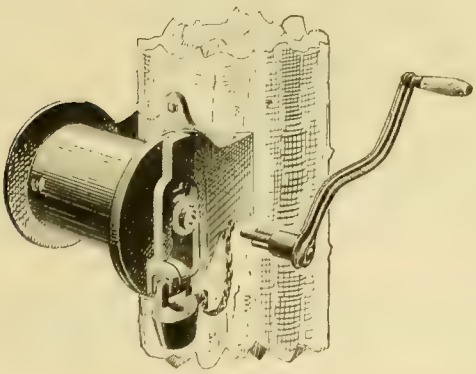

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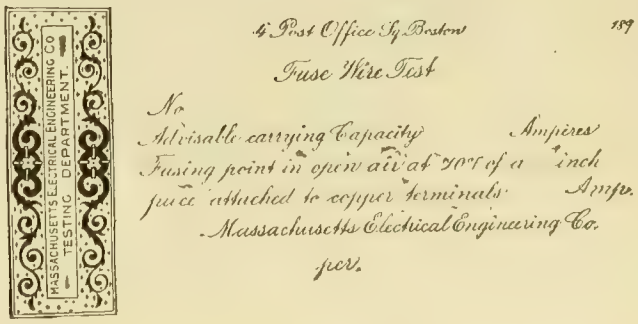

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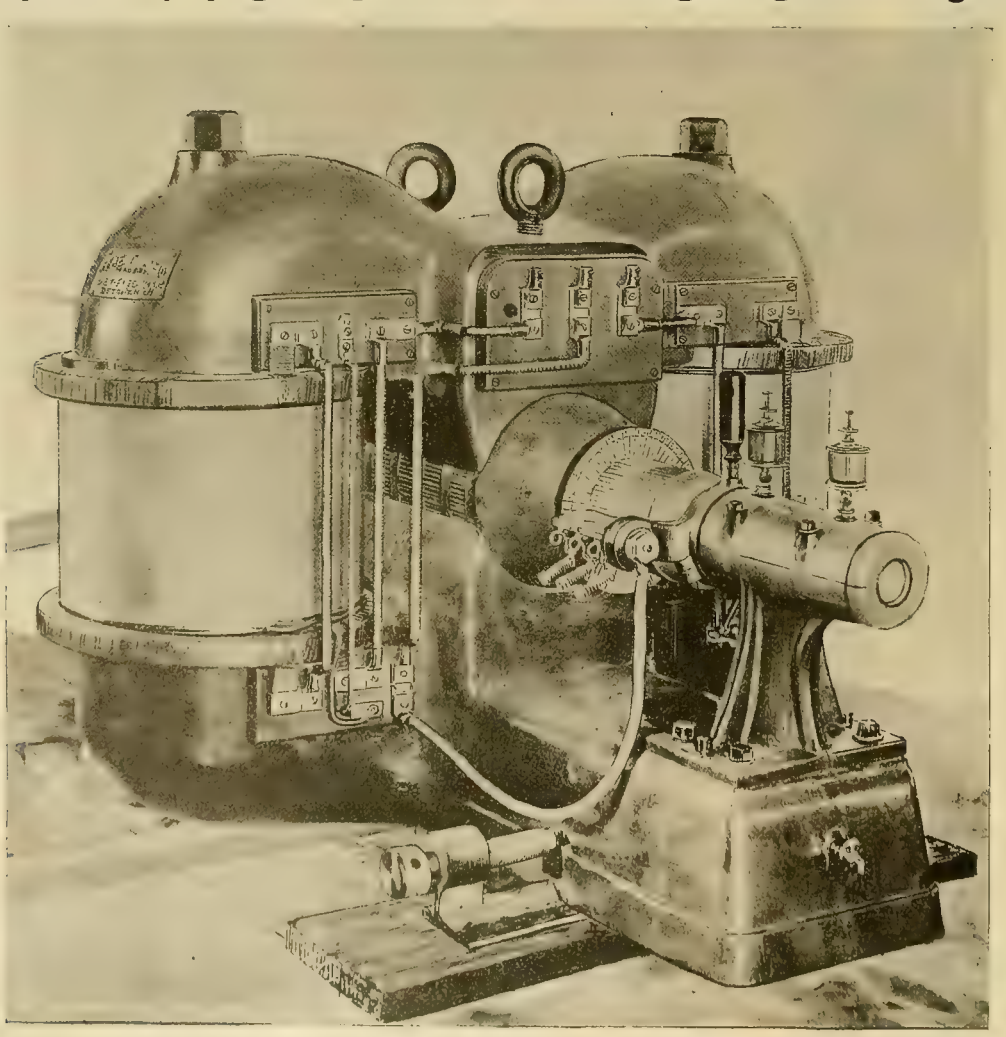

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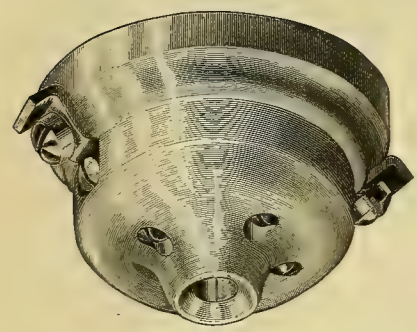

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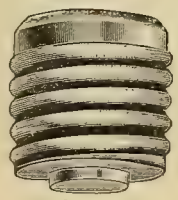
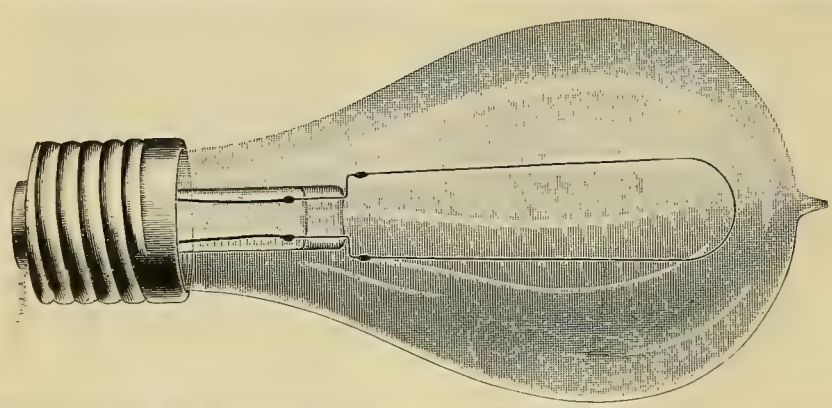
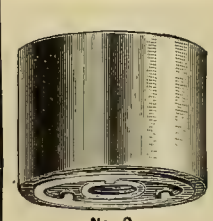


No. 1.
Edison Base.





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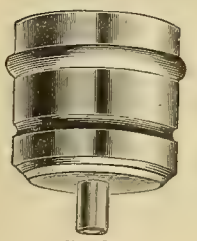

No. 3.
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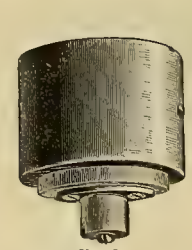

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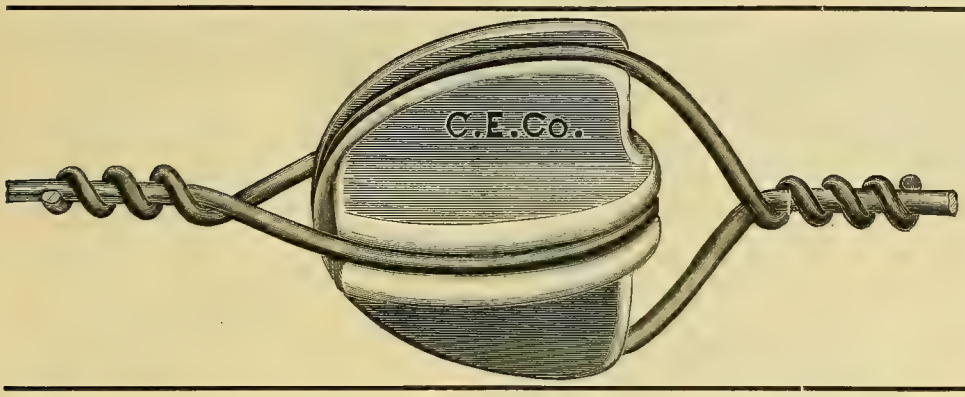

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For Suspending Arc Lamps, Insulating Guy Wires, Insulating Span Wires in Electric Railroad Work, is so simple and perfect in construction as to need no explanation.

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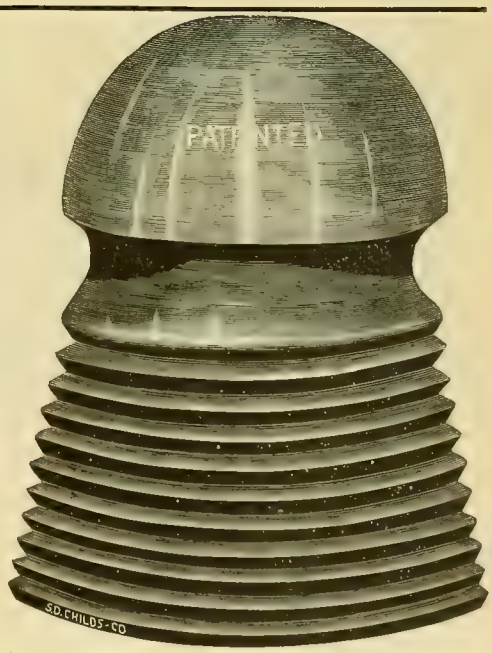
HIGH RESISTANCE GLASS INSULATOR



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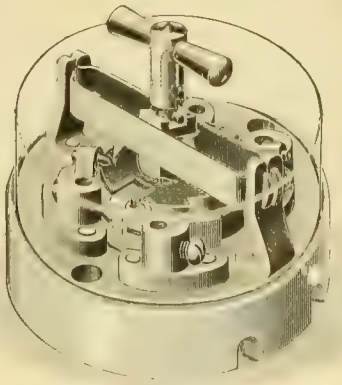

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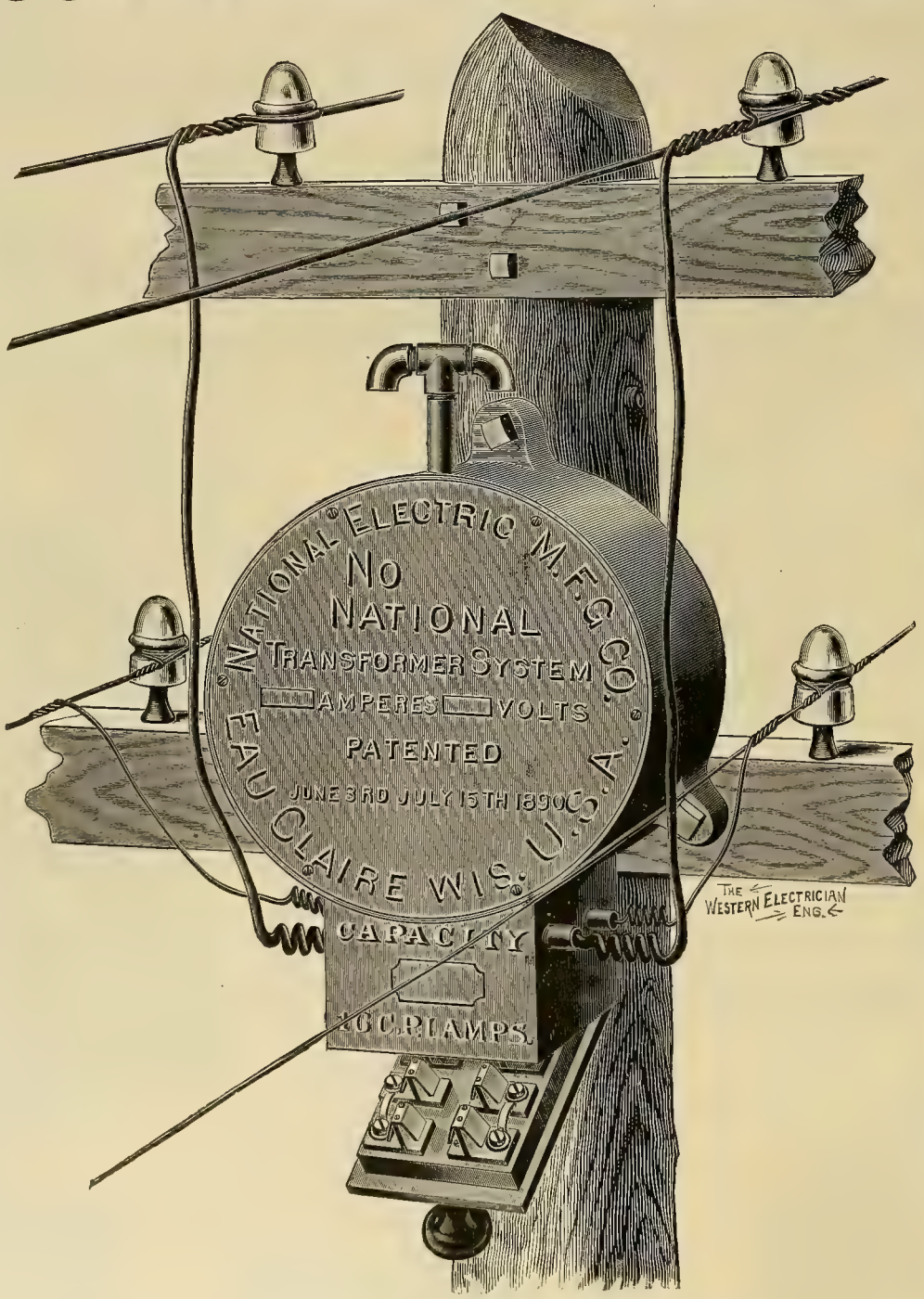

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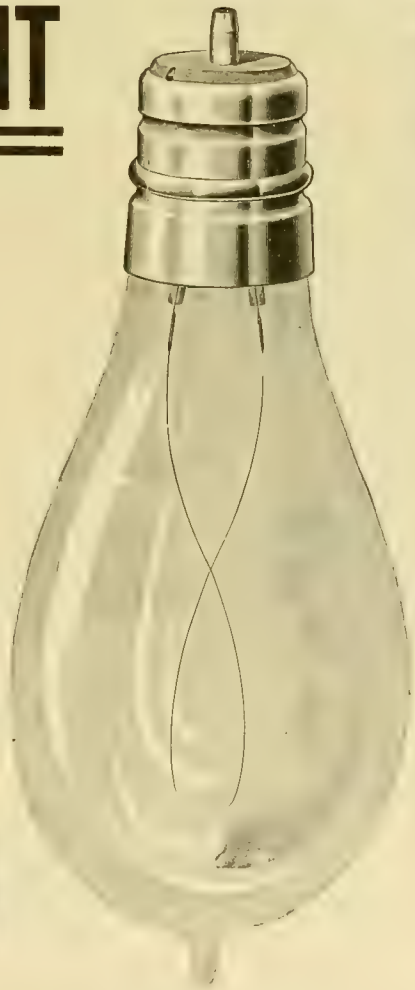

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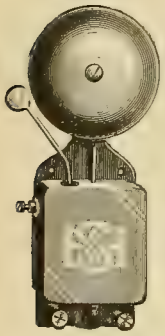

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Yours truly,
EMIL GRAH,
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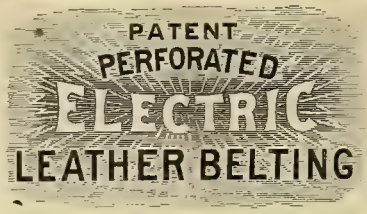

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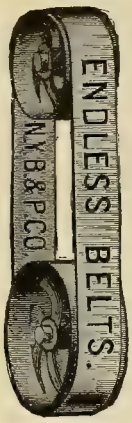

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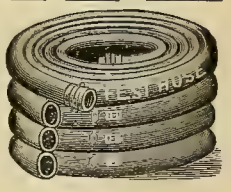

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EVERY SATURDAY.

Vol. VIII. CHICAGO, JANUARY 24, 1891. No. 4

London Underground Electric Railway.

The opening for passenger traffic of the underground electric road in London, Dec. 18, was unquestionably the most important electrical event in England in 1890. The installation is one that will be watched with great interest in the United States as well as in England. In this country a number of similar enterprises are under consideration, although none of them has yet reached a definite stage. It is stated that the extension of railway accommodation, which London needs so urgently, depends to a great extent upon the failure or success of the road; Englishmen, therefore, are watching the road with no little interest.

Through the courtesy of Mather & Platt of Manchester, the contractors of the road, and Edward Hopkinson, consulting engineer, the WESTERN ELECTRICIAN is enabled to present two views, which give a better idea of the road than any illustrations thus far published. Fig. 1 shows several of the 100-horse power locomotives, and the locomotive sheds. In Fig. 2 is illustrated an electric locomotive drawing a train of coaches. The details of the installation were given in the WESTERN ELECTRICIAN of November 29th.

The entire cost of the undertaking was, according to a rough estimate, $3,800,000. The road is about 3¼ miles in length, and the cost of construction alone was about $1,10 ,000 per mile. The road will be operated from 7 A. M. to 12:30 A. M., and trains are run every five minutes. It is estimated that the road will carry 11,940 passengers daily, and that the total income of the railway will be $164,000 per year. These figures have been worked out by one who is by no means inclined to look on the brightest side. According to his estimate those interested in the road may confidently expect a yearly return of 2⅛ per cent. Other authorities are inclined to believe that this figure is too low.

Eight trains will be able to maintain a five-minute service in both directions. Each train will run a distance of 10 miles per hour, or 1,400 miles per day for the eight trains, and the mileage for a year will, with continuous operation throughout the 17½ hours daily, amount to 511,000 miles.

FIG. 1. LONDON UNDERGROUND ELECTRIC RAILWAY—LOCOMOTIVES AND SHEDS.

At a recent meeting of the Technical Society of the Pacific Coast at San Francisco, a paper was read by R. Welder on "Electric Accumulators and their Appliances."

Electric Light Legislation at Springfield, Illinois.

The first bill providing for electric lighting by cities was introduced in the Illinois legislature last week by Representative James P. Wilson of Woosing, Ogle county. Mr. Wilson is a farmer, and desires to teach his friends in the city how to conduct their affairs. The bill in question is designed ostensibly "to allow cities organized under special charters to create and maintain a plant for furnishing light." The provisions of this bill have not yet been made public, but they will undoubtedly prove interesting.

The bill favored by Mayor Cregier of Chicago has not yet made its appearance at the state capitol. It is possible that it may not be presented. The committee having the "reform" movement in charge is divided as to the best method of procedure, and many citizens are opposed to any measure that will place additional power in the hands of the present city administration. The mayor, however, may secure the presentation of his bill through some personal follower, who occupies a seat at Springfield.

The electric light plant at East Lobe, Ala., will be enlarged.

Manhole Explosion in Chicago.

An explosion in a manhole at the corner of Jackson street and Wabash avenue, Chicago, January 17, proved the first fatality in connection with the underground service in that city. The explosion occurred in one of the city conduits. The iron cover of the manhole was blown into the air, a part of it struck Mrs. Ross, a colored woman, and killed her instantly. Several persons were slightly injured. Immediately following the explosion there was a crash of falling glass, and the sidewalks in the neighborhood were covered with fragments of broken glass. The windows about the scene of the explosion were shattered into thousands of pieces. The explosion naturally caused a sensation, and many wild statements were circulated. Of course the cause of the explosion was at once laid to the electric wires, yet, when the matter was investigated it was found that the only live wires in the conduit in service were fire alarm wires. The city electric light wires were in the abandoned mains leading to the Lake Front, and the arc light company's wires leading to the exposition building were dead. The change in the city's plans, made necessary by the decision that the Lake Front could not be occupied by a power house, was not made until this conduit had been built and the wires drawn in. Those who were in the neighborhood at the time of the explosion could easily detect the odor of gas. It was evident that there was a leak in the gas mains near by.

Prof. Barrett said the conduit in the "dead end" of the South side system was the best constructed in the city, but it was simply impossible to build a conduit in Chicago to-day that would keep out the gas. The gas companies' mains are so poorly laid that a great part of the output is lost in transmission. In summer a portion of this gas forces its way to the surface, but in winter when a crust is formed by the frost and a larger percentage of the gas penetrates the conduits, the danger from explosions is greater. The combination of illuminating and sewer gases has caused no end of trouble in underground work. There had been many explosions along the mains in Chicago, but never before has there been a fatality. Most of the "explosions" have merely raised the covers of the manholes a couple of feet, without doing any damage or disturbing anybody.

Prof. Barrett suggests that provision be made for thoroughly ventilating every conduit in Chicago. This can be done, but a comprehensive system would necessitate the expenditure of considerable money. "It is the only way, however," said the city electrician; "and after that unfortunate affair of Saturday last there should be no hesitation about making the necessary appropriation." A workman who has had considerable experience in underground construction calls attention to the fact that at times it seems almost impossible to get the gas out of the conduits. He said: "I have often removed the cover of a manhole, and after half an hour would attempt to enter but would be driven out by the gas. There seems to be a peculiarity about it. Many a time I have had to help the boys out when they were overcome by the gas."

The Telephone and Telegraph in Germany.

G. H. Sachse of Berlin, Germany, was in Chicago last week inquiring into the operation of the postoffice department. Mr. Sachse is director of the post and telegraph department of the German Empire, and on his return to his native land he says he will introduce many improvements suggested by the service in this country. He believes, however, that the system in Germany is superior to that in this country in one respect, at least, that it is more extensive, embracing as it does the telegraph and telephone, as well as the postal service. His views on this subject will be interesting to Americans: "I think it would be much better if your telegraph and telephone service were under the control of the government. The nation certainly should have charge of the telegraph system, and it would be much better if the telephone system was under state or municipal control. I understand the telephone subscribers of Chicago have to pay $150 or $125 annually for the use of the service. The charge in the German Empire is not one-third of that amount, patrons being required to pay but $37 a year. The charges for telegraph service are also more reasonable than here. Telegraph and postal tolls are the same all over the empire. Letter postage costs 2½ cents, telegrams 15 cents for ten words, or 1½ cents a word."

The distinguished visitor added that the service in Germany gave employment to 100,000 men, and that all felt secure in their positions as long as they performed their duties. He had been in the service thirty-six years, he said, and the director-general of the posts had held his position twenty years. It would be hard to find an official as high in authority as either of these men holding his position twenty or thirty-six years under the government in this country, and this of itself is a significant fact. Frequent changes are made here, and politics permeates every department of public service. It will be readily seen that this rule applied to the telegraph and telephone, if under government control, would soon impair the efficiency of the service.

It should be borne in mind, too, that the changes in the other departments are not only made in important positions, but throughout the entire list. For instance in the postoffice department the carriers' positions are not secure if there is a change at Washington. The comparison instituted between the rates in vogue in Germany and those in Chicago is unjust without further explanation. In the first place the relative value of money in Germany and this country enters into the problem. The wildest advocate of governmental control of the telephone and telegraph never dreamed of furnishing service at $37 per year in this country. When it is considered that the wages paid here and the cost of material are much higher than in Germany, the true state of affairs can be realized. Then again if the government were to take control of the telephone it would mean an immense investment of public funds, which the people would have to furnish. At present the vast industry is conducted by private capital. All of these considerations and many others have a bearing on this question.

FIG. 2. LONDON UNDERGROUND ELECTRIC RAILWAY.—PASSENGER TRAIN.

Telegraph Operators' Troubles.

An unfortunate but nevertheless interesting controversy between the telegraph operators and agents of the C., M. & St. P. Railroad company and their employers has occupied the attention of railroad men generally during the last week. The trouble was due to a question of wages. The employes' story as given by a representative, is as follows: Several weeks ago a hundred or more operators and agents on the C., M. & St. P. railway were notified that their salaries had been reduced on an average 15 per cent. and no reason given therefor. Almost simultaneously with this action a committee from another department of the service made a demand for an increase, and received it. The operators and agents, believing that an injustice had been done them, started a petition over every branch of the system and received the signatures of 80 per cent. of the men in service, to the effect that a committee should be selected and sent in to the general manager to ask for an adjustment. As the canvass was nearing a close, the officials became aware of the movement, and proceeded to send out specials, interviewing all the men and ordering them at

once to withdraw their names under penalty of discharge. The great majority of those who signed declared that they would remain firm and demand the restoration. A committee representing the dispatchers, agents and operators visited Chicago, seeking an adjustment. The situation, as stated by the men, was as follows: If the restoration is not granted or if a portion of the men are discharged because they will not withdraw their names from the petition, 500 men or more will resign.

It is interesting to note the position of those identified with the O. R. T. on this question. This organization professes to be opposed to strikes, yet its official organ pleads the cause of the strikers in this case; its treasurer is engaged in raising a relief fund and members of the order took a prominent part in organizing the strike. It will also be noted that in all the statements of the men there is no allusion to a strike. They say they will "seek employment elsewhere," finding that their demands are disregarded. Of course they did not intend to do anything of the kind, nor do they contemplate such a movement. On the contrary, their idea was to cripple the railroad service and wring from their employers concessions. If there was any doubt on this point their own action would settle it. They have appealed to the men throughout the country, as has also the official organ of the O. R. T., to support them in their fight and not take the positions vacated by the operators. Strikes are not popular and they are declining in favor every year, yet it would be far more manly for the operators to declare their intentions openly, or say nothing about their plans.

It is earnestly to be hoped that the difficulties will be adjusted satisfactorily. The men cannot afford to lose their time and the public cannot stand the inconvenience of a big strike.

Regulating Telephone Charges In Illinois.

The opponents of the Chicago Telephone company have organized a movement to secure the passage of an act by the Illinois legislature regulating the rates for telephone service. In order to secure the support of the representatives from the rural districts the bill is made to apply to all parts of the state. The Druggists' association, which has fought the telephone company so bitterly in Chicago is the special champion of the bill now under consideration. In this act it is provided that a rental not to exceed $70 may be charged for residences, $80 for stores and offices, and $100 for public telephones. Penalties ranging from $200 to $1,000 in fines are provided for violations of this bill.

A movement is being started in Vienna and Budapest to obtain a concession for the carrying out of preliminary works for an electrical railway between Vienna and Budapest. A speed of 100 kilometers per hour it is asserted is to be attained, and the distance is to be accomplished in about three hours. In the technical departments of the Ministry of Trade the project is looked at very skeptically, and is considered premature in view of the present condition of transmission of power from a distance. No decision has yet been given in the matter.

Edison Station at Des Moines, Ia.

The accompanying cuts illustrate the switchboards of the Des Moines Edison Light company's new station, of which cuts and a brief description appeared in the last issue of the WESTERN ELECTRICIAN. Great care was taken in designing this plant with the idea of making it a model station. The main objects in view were to secure steam power as cheaply as possible, and to reduce operating expenses to a minimum. To accomplish these objects it was decided to erect the new station near the river where an abundant water supply could be obtained for condensing purposes. The building was so arranged that all the machinery and apparatus are located on the ground floor, and the plant could thus be operated by the least number of attendants.

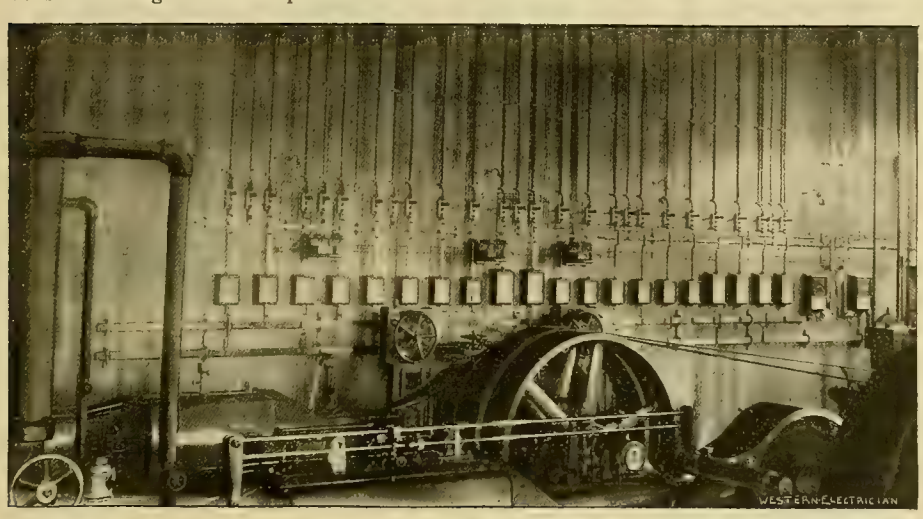


FIG. 1. EDISON STATION AT DES MOINES.

The structure is 98 feet wide and 115 feet long, and is located at the foot of Chestnut street, on the West side. The building is brick, one story high. The roof is composed of iron trusses, on which rest the wood perlius and wood sheathing covered by building paper and tin roofing. The front part of the building is divided off by brick partitions into offices, meter room, store room and work shop, and the rear of the building is divided by a central wall into a boiler room on one side and engine and dynamo rooms on the other. The chimney is six feet square, inside, and 125 feet high. It is located nearly in the middle of the boiler room. The station is designed to accommodate a steam plant of 1,200-horse power capacity, of which about one-half has already been installed. The present boiler plant consists of three Heine Safety boilers, with a total capacity of about 600-horse power. The engine plant consists of two Williams' high speed compound condensing engines, operating two dynamos each, and one 16x32 single cylinder Buckeye engine, making 122 revolutions per minute. The latter is also belted direct to two No. 20 dynamos. This arrangement is rather a new departure, as the speed of the engine is slow, and a countershaft is usually employed. This engine has a double crowned fly wheel, 10 feet in diameter and 27 inch face. The power is transmitted to pulleys 18 inches in diameter on the dynamos, by two 12 inch leather link belts, the operation of which is entirely satisfactory. Each of the engines is provided with a Deane independent condensing apparatus, and the exhaust pipes are so arranged that either engine can be operated non-condensing if desired. The water for condensation is taken from theriver into a well near the building, through a 24 inch conduit. An independent suction pipe is run from this well through a pipe trench to each of the condensers, which are located in pits about six feet deep, arranged between the engine foundations. The feed water is taken from the hot well, and pumped through a closed heater, where its temperature is raised by the exhaust from the feed and tank pumps, thence it flows into the top of two Hoppes' live steam purifiers. Each purifier is 40 inches in diameter, and 19 feet long. They are supported on iron girders above the boilers, and the water flows by gravity from the purifiers to the boilers. The water in this locality is very hard, and it is necessary to purify it by live steam before it can be used satisfactorily for steam purposes.

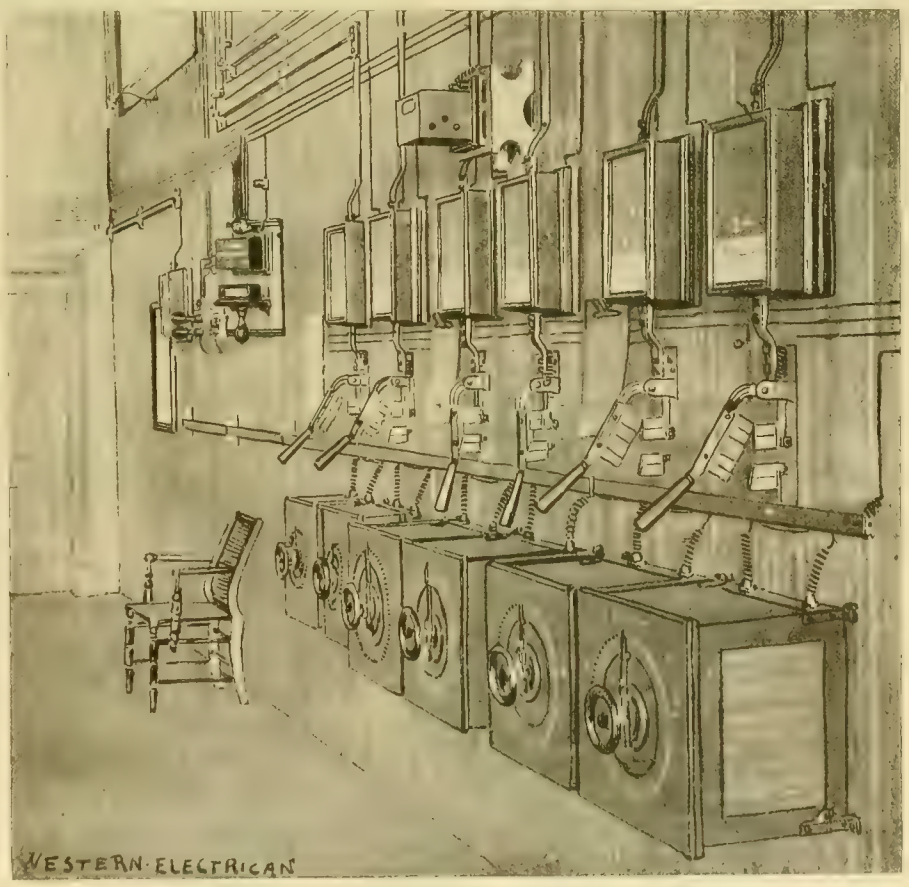


FIG. 2. EDISON STATION AT DES MOINES.

The three-wire system is used throughout this installation. The operating switchboard, which is shown in Fig. 2, contains the

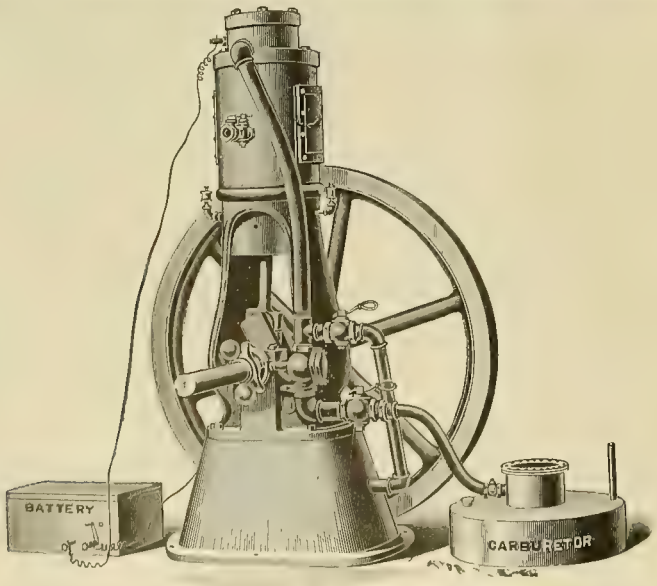
neutral conductors leading from the dynamos. In each of these conductors is placed an ampere meter and a switch by which either dynamo can be cut in or out of circuit. A galvanometer is placed on the positive and negative side of the switch-board, and can be switched on as a shunt across either of the main switches by which the e.m.f. of each dynamo can be compared with that of the general circuit before closing the switch. The dynamo regulators are placed directly under the switch to which they belong, and the positive and negative pressure indicators and galvanometers are placed on brackets at the ends of the switch-board in such a manner that all of them can be viewed from one point. The whole presents a symmetrical and neat appearance, and are convenient to operate.

The distribution board is shown in Fig. 1, and contains, besides the two large "bus" ampere meters to the right, ten sets of feeders with their respective ampere meters, fuses and plug switches, and a number of comparative indicators for comparing the pressure at the ends of the feeders with that of the standard feeders. The feeders are run from this switch-board up to a tower where they connect with an overhead system of feeders by which both light and power are distributed over a large territory on both sides of the river.

The installation of this station was made by the Edison General Electric company, under the direct supervision of Augustus Hanson, constructing engineer for that company, who designed the general plans of the station building, and made all detail drawings for both the steam electrical plants, and superintended the construction of the entire station. After the plant was completed and put into satisfactory operation it was turned over to J. A. Colby, the manager for the local company.

Regan Vapor Engine, Battery and Carburetor.

In the accompanying cut is illustrated a Regan vapor engine, with battery and carburetor. Gas may be used as fuel, but gasoline is generally adopted. The engine is operated by means of vapor drawn into the cylinder by the suction of the piston and ignited by an electric spark. The carburetor, as shown in the illustration, contains a small quantity of gasoline and is connected with the engine by a pipe, as shown. At each revolution of the fly-wheel a current of cool air is drawn through the carburetor and into the cylinder. In passing through the carburetor, it vaporizes a quantity of the gasoline; this, when mixed with more air drawn through the pipe and air-valve, forms the charge which, upon combustion, develops the power.



REGAN VAPOR ENGINE, BATTERY AND CARBURETOR.

This charge, as already stated, is drawn into the cylinder as the piston is drawn out by the crank and fly-wheel; on the return stroke it is compressed in the head of the cylinder, and just before the piston arrives at its highest point or "upper dead center," a shoulder or point projecting from it comes in contact with a flexible piece, the two comprising the poles of the small battery thus completing an electric circuit which is broken when the piston passes its center and commences to descend. At the instant of separation the spark is em tted, firing the charge. On every other stroke of the piston this is repeated automatically, save when the supply is cut off by the governor, which not only controls the engine but at the same time cuts off the supply of gas, so that when less power is being used proportionately less gas is consumed.

The Regan vapor engine is built both upright and horizontal, from ½-horse power upward, both for stationary and marine purposes. Thomas Kane & Co., Chicago, manufacture this engine. They have a horizontal machine operating a pump in their building on Wabash avenue, Chicago.

Lightning Arrester.

The instrument shown herewith, which is the invention of Elihu Thomson of Lynn., Mass., is

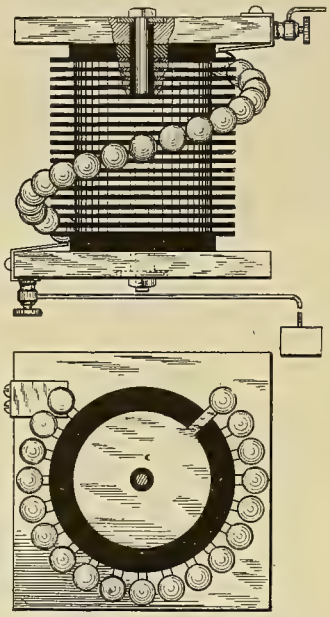


FIG. 1. LIGHTNING ARRESTER.

based on the principle that where the discharge spaces in an arrester are in series and of a total length when added together, equal to several times that over which the discharge could pass if caused to leap across the single pair of discharge plates in an ordinary lightning arrester, there is secured not only freedom of discharge of current but at the same time freedom from the formation of and continuance of arcs between the discharge surfaces. In other words, Prof. Thomson finds that when a discharge has taken place, and the potential of the line is such as would tend to maintain an arc at the breaks the potential can readily be made insufficient to do so by multiplying the number of striking-spaces. He also finds that an arc is much more readily maintained between two plates with a single wide space than between a succession of discharge points or over a succession of spaces placed in series.

The construction of the arrester will be understood from the cut. In Fig. 1 is shown a

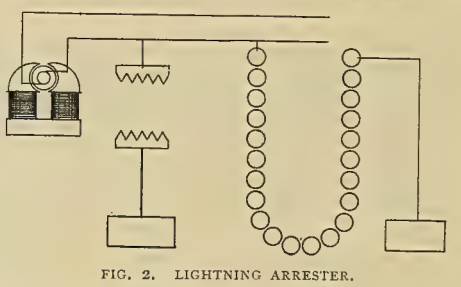


FIG. 2. LIGHTNING ARRESTER.

side and plan view of the device. Fig. 2 is a diagram representing the arrangement of the new arrester as compared with an ordinary comb arrester, if the serrated plates were extended to give a disruptive space equal to that obtained in the improved form.

Referring to Fig. 1 it will be seen that the device is composed of a series of metallic plates separated by hard rubber washers, each washer projecting a little distance outside of the metallic plates. Each plate, as represented in the plan view, Fig. 1, is provided with a lateral projection, and carries a discharge terminal, in the form of a ball. The discharge-points or balls can be adjusted as to distance by simply swinging the plates around so as to arrange the balls in a spiral fashion around the column of plates. At one end of the series is a connection to the line, and at the other end is a connection to earth. Provision is made so that additional plates might easily be built up on top of the column so as to increase the number of discharge-points and adapt the apparatus to working with higher potentials on the line. The metal pieces interposed between each successive break should have some capacity for static charge, as this facilitates the successive breaking down of the disruptive spaces by a lightning discharge or sudden static effect.

Wirt Arc Lamp Hanger.

The new arc lamp hanger shown in the cut was designed by Chas. Wirt of Chicago. It is so made, it is stated, that it combines simplicity, strength, and very high insulation. A good quality of hard rubber is the insulation used, and the design is such that the full benefit of the high insulating qualities of this material with a large corrugated skirt surface is obtained.

WIRT ARC LAMP HANGER.

At the same time the quantity of material required is small. The metallic inclosing case protects the device from the weather effectually and at the same time supports the hard rubber, so that the strength is ample. It has heretofore been customary to use glass petticoat insulators where extremely high insulation was required in suspending arc lamps on high tension circuits. The design of an unbreakable device, with even higher insulation than can be secured by means of glass, will be generally appreciated. The hanger is introduced by the Electrical Supply company.

Devices for Protecting Telephone Circuits from Heavy Currents.

When a telephone wire falls across a badly insulated electric light conductor or the trolley wire of an electric railway, the results at the exchange are, as a rule, quite disastrous. To protect from these powerful wandering currents the necessarily delicate and expensive mechanism employed in telephone and telegraph systems, is a problem to which a number of electricians have devoted no little time. One of the latest forms of cut-out which is said to be operating satisfactorily, is shown herewith. This device is the invention of Albert Barrett, electrician of the Missouri & Kansas Telephone company, Kansas City, and is employed, it is stated, quite extensively on the switch-boards

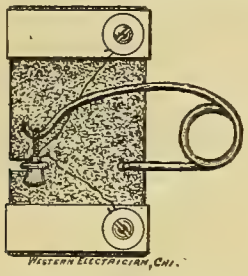


FIG. 1. DEVICE FOR PROTECTING TELEPHONE CIRCUITS FROM HEAVY CURRENTS.

in that city and at other points covered by this company. The construction of the cut-out is quite simple. The line wire is cut and each of the two ends is fastened to the binding-screws shown in the illustration at the upper and lower right hand corners. A very fine German silver fuse wire connects the binding-screws as shown. The fuse wire is arranged in a peculiar manner. Before being put in place it is passed through and by means of a little drop of wax molded onto, so to speak, a small loop of cord. The loop of cord is passed up through an eye and, as the drop of wax is a little larger than the eye, serves to hold down a spring, as indicated. The operation of the cut-out is as follows: The moment a current of dangerous volume passes through the fuse wire, the wax button holding the loop and spring in place, melts. This action sets free the spring and the quick jerk of the loop through which the heated wire passes, breaks the latter.

In Figs. 2 and 3 is illustrated another device designed for the same purpose by J. J. O'Connell, electrician of the Chicago Telephone company. Mr. O'Connell's cut-out will be understood more clearly by reference to the cuts. In the

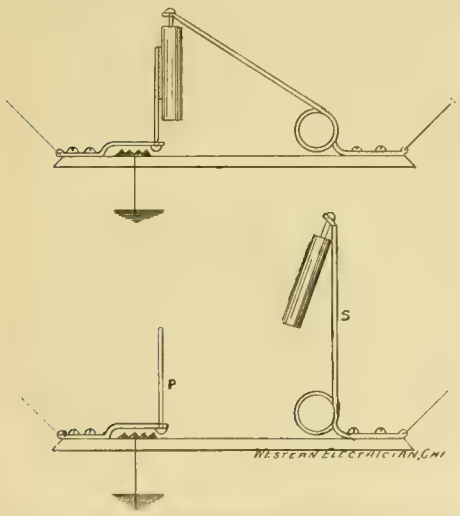


FIG. 2. DEVICE FOR PROTECTING TELEPHONE CIRCUITS FROM HEAVY CURRENTS.

diagrams *S* is a steel spring formed with an eye on the end. From the eye swings the cylinder shown in detail in Fig. 3. This cylinder is made of copper in a manner similar to a cartridge shell and has a groove pressed into one side as shown in the sectional view, Fig. 3. A coil of silk-covered No. 36 German silver wire is wound around a large common pin, connected as shown, and, after the shell has been filled with soft plaster of Paris, is forced down into place. This construction brings the coil close against the depressed portion of the tube. The action of the device is as follows: The tube is pulled down and by means of any soft solder, or even wax, united to and kept in good electrical contact with a pin *P*. When an abnormal current passes, the solder or wax melts by reason

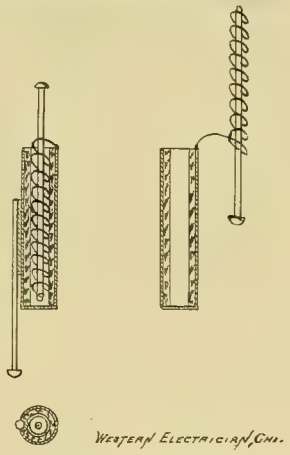


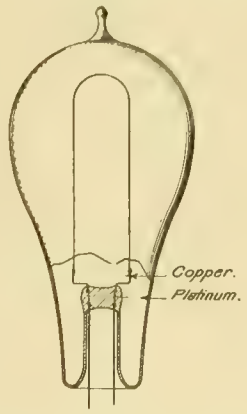
FIG. 3. DEVICE FOR PROTECTING TELEPHONE CIRCUITS FROM HEAVY CURRENTS.

of the heat evolved from the German silver wire coil, and the circuit is opened.

Economizing Platinum in Incandescent Lamps.

In the manufacture of incandescent lamps the filament is connected to bits of metal called the "leading-in" conductors. By means of these little pieces of wire the filament within the sealed glass globe is connected with the outside circuit-wires. To maintain a stable vacuum it has been found best to make the leading-in wires of platinum, since its coefficient of expansion is so nearly the same as that of glass that less trouble is caused by its expansion and contraction than is experienced with other metals. It has been the usual practice to introduce the platinum leading-in wires into a glass tube, and then to fuse and compress the tube around the wires in this manner, tightly sealing them into the glass. These wires have necessarily been of a considerable size, not for electrical reasons but for mechanical reasons, since they are required to support the filament, and to be of such rigidity that they will not be bent by the weight of the filament or by jarring. Of late, however, platinum has advanced very materially in price, and manufacturers are endeavoring to provide a substitute for the metal, or a means by which the amount used in a lamp may be reduced to a minimum. With this object in view Mr. Edison has devised the arrangement of leading-in conductors illustrated in the cut.

Wires of copper, iron, nickel, silver, and other metals, and some alloys having a greater coefficient of expansion than platinum, can be sealed into the glass; but on cooling, although they will still be held mechanically rigid by the



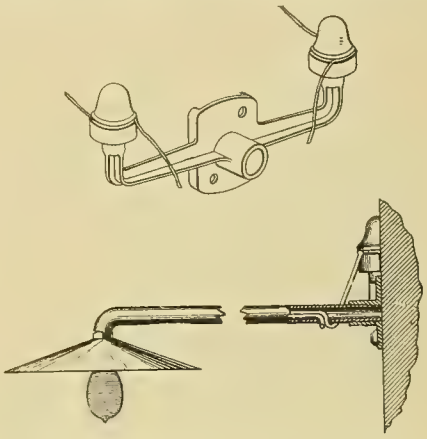
ECONOMIZING PLATINUM IN INCANDESCENT LAMPS.

glass, they contract sufficiently to permit air to pass into the vacuum. The peculiar feature of Mr. Edison's process is that leading-in wires of two metals are used, one section being of a metal having substantially the same coefficient of expansion as glass, such as platinum, the other being of a different and cheaper metal. Conductors thus formed of two metals are sealed into the glass, as shown in the illustration. The seal will remain perfect at the platinum sections, and it will, therefore, be immaterial if the copper or other wire contracts away from the glass.

Simple Lamp Bracket.

The cut shows the general features of a new electric light fixture designed by T. Carpenter Smith of Philadelphia.

This bracket consists of a plate carrying insulators to be fastened against a pole or wall,

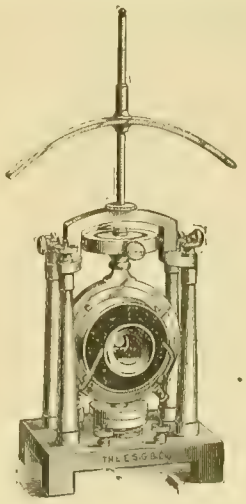


SIMPLE LAMP BRACKET.

and a pipe extension arranged as represented. The pipe screws into a socket in the plate, and carries at its outer end a lamp and shade. A practical feature of the rigging is that the wires pass from the insulators to the lamp through the pipe, entering through a hole in the under side.

Frey Portable Reflecting Galvanometer.

The galvanometer shown in the cut is the invention of Charles P. Frey, chief electrician of the Greeley electric laboratory. It embodies the essential features of Thomson's reflecting galvanometer, and is extremely sensitive. Its principal feature is that it can be instantly prepared for use by releasing the coils, which are suspended by means of a universal joint, and thus require no leveling. When not in use the fiber-suspended magnet and mirror, as well as the pendant coils, are securely locked by means of a compound bolt operated by one turn of an



FREY PORTABLE REFLECTING GALVANOMETER.

independent key. The danger of breaking the fiber to which the ordinary type of fiber suspension is liable when at all roughly handled, and which may be a serious annoyance, it is claimed, is therefore obviated.

The galvanometer is especially adapted for rapid subway testing, since it may be rendered direct reading by attaching a pointer. For more delicate tests, by using a lamp, stand and scale, great accuracy, it is stated, can be obtained. The galvanometer is placed on the market by the E. S. Greeley & Co., of New York.

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W. A. KREIDLER, - - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - } Associate Editors.
J. B. O'HARA, - - - - - - - - - - }
F. L. PERRY, - - - - - - - - - - }
A. C. DURBOROW, JR., - - - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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"COMMERCIAL Rating of Electric Generators" is the title of a paper read by Thos. G. Grier at the last meeting of the Chicago Electric club. The paper is presented in another column. Mr. Grier takes the stand that the present method of rating a generator by the total number of lamps or motors it is designed to supply is wrong. He points out errors which may occur from such rating, and refers particularly to the inaccuracies which exist and are due to the variation in the efficiency of the numerous types of incandescent lamps now on the market. We agree with Mr. Grier in the general tenor of his paper. Dynamos should be designated according to their capacity expressed in watts. To draw up a specification and require that a machine shall have a capacity of so many 16-candle power lamps or so many 2,000-candle power arc lamps, may, perhaps, be accurate enough where the buyer is an engineer and has exceptional facilities for making combined photometric and electrical measurements. The more satisfactory method, though, would seem to be that in which the generator is rated according to its output in watts, and the lamps designated with reference to the electrical energy consumed in each, and its efficiency. Such a plan would simplify the specification and leave little margin about which the customer could quibble when called upon for his acceptance of the plant. We often refer to our English cousins as lacking in progressive spirit. In the present instance their practice might be studied with advantage by those who claim to lead the world in electrical matters.

THE collector of customs at Buffalo, N. Y., recently submitted to the Treasury Department the question whether natural gas imported into that port from Canada is liable to duty under the tariff law. The decision in the case was written by assistant Secretary Spaulding who gave it as his opinion that gas was a dutiable product. He says: "Under the circumstances mentioned, the department concurs with you in the opinion that illuminating gas is wholly different from electricity, and that as it is a merchantable commodity which can be measured as readily as liquids and other gases, it would be liable to duty on importation." No one, we think, is anxious to have a duty on electricity, still the reason here assigned for the distinction drawn between gas and electricity can scarcely be commended. Electricity can be measured as readily as gas, and according to popular belief with a great deal more accuracy. Unless there are other valid reasons for drawing distinctions between gas and electricity it would seem as if the opinion of the Treasury Department was hardly well grounded.

IT is prophesied that the stage will soon become one of the most profitable fields in which the electrician may exercise his ingenuity. The statement comes from Neil Burgess, whose opinion is of no little importance, for the reason that his electrical apparatus for representing a horse race on the stage, has netted the inventor a considerable amount of money. His invention was patented, and the patent has recently been sustained. Burgess believes that electricity will revolutionize stage management in a few years. He says that by the use of electric motors the whole mechanism of a complicated play can be put under the control of a single man, and manipulated with such facility and rapidity as to very much reduce the waits between acts, and entirely obviate any of the exasperating hitches which otherwise might sometimes occur. He proposes still further to increase the application of motors to his own stage setting, so that as far as possible, all mechanical devices and movable scenery, curtains and the like, will be handled by motors from one point with great rapidity, and without the danger from careless attendants.

THE London *Electrician* in its issue of January 2 reviews an article on the "Electrical Department of the World's Fair" recently published in the WESTERN ELECTRICIAN. Our contemporary represents itself as the most crabbed and ill-natured journal published; but in spite of its endeavors in this direction it has not imposed on us for an instant. Nothing could convince us that the *Electrician* is as ill-humored and as cynical as it would have us believe. We are not a bad lot on this side of the Atlantic by any means, and the *Electrician* knows it in spite of its polysyllabic epithets. In the article in question the necessity of securing foreign exhibits was pointed out which led our contemporary to remark that "this sudden solicitude as to foreign exhibits is somewhat strange in the citizens of a republic which, as is well known, is the universe in miniature." Now that is an extraordinarily unkind remark to make after the kind words we have said about our foreign friends. Then again, it tries to throw cold water on the whole project by exclaiming: "Sentiment has but a small place in business affairs, and yet it would be little else than sentiment for a European firm to send its wares several thousand miles across the sea to such an electrically self-sufficient country as the United States of America." And what would the world be without sentiment, pray? Our foreign friends will be well represented at the World's Columbian Exposition, of course. They do not show the bitter feelings which the *Electrician* expresses, but cannot believe. As arrangements for the fair progress we expect to see even the *Electrician* fall into line and do what it can to contribute to the success of the exposition, even if in the meantime it does not express its contrition for its ill-natured remarks.

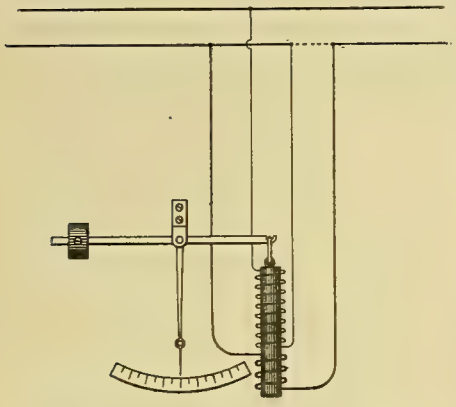
ONE of the most interesting electrical installations now attracting public attention is the underground electric railway in London. Two views of the road are presented in this issue, which we think give a better idea of the general character of the equipment than any illustrations which have been published either in England or in this country. The views are reproduced directly from photographs sent to the WESTERN ELECTRICIAN by those interested in the railway. The successful operation of the road has stimulated in no small degree the demand for the construction of a similar railway in New York city. The plan of an underground railroad in the metropolis up to the present time has been objected to on account of darkness, smoke and dust. As it is now proposed to operate the road by electricity, these objections lose their force. A report of the meeting of the New York rapid transit commission at which the subject was considered, is given elsewhere in this issue. An English engineer familiar with the operation of the London railway was confident that the construction of a similar railroad would afford New York greater relief than any other rapid transit system.

THE unfortunate accident in Chicago last week which resulted in the loss of life in one instance, painful though not serious injuries in several cases, and the destruction of considerable property, is attributed by the daily papers to the "deadly manhole." It is true that the explosion in a manhole was the direct cause of the fatality and other damage referred to, but an investigation into the cause of the explosion reveals the fact that the electric wires had nothing to do with the catastrophe. The conduit in which the explosion occurred contained fire-alarm wires and cables which had been intended for use in the city's South side system, but which were made useless when the lake front site for a power house was abandoned. There is no question but that the disastrous explosion was chargeable to the Gas trust, and it should be held responsible. Those who visited the scene of the accident noticed the obnoxious odor of gas. This is not only true of Saturday night, but the following Monday. The fact of the matter is that the gas mains of Chicago, and the same may be said of other large cities, are so wretchedly constructed that a very large percentage of the gas sent out from the works is allowed to escape. It permeates residences, gets into the sewers, and poisons the air. The city of Chicago endeavored to guard against just such accidents as that which occurred Saturday. Special attention has been given to the question of keeping the conduits free from gas, yet it seems impossible to do it. The gas company recklessly pumps its product into poorly constructed mains. The result is that the conduits are filled with gas. All the money expended by electric companies in costly conduits is thereby rendered useless. This question of keeping the conduits free from gas is becoming more and more serious each year, as the extension of the underground system progresses. Just now those interested in electric lighting are endeavoring to secure a system of ventilation for conduits on which they may rely and in which provision may be made for the future.

It was demonstrated to the satisfaction of the coroner's jury which investigated the case that the explosion was due to a leak in a gas pipe and carelessness on the part of the workmen who were sent out to fix it. One of the workmen acknowledged the facts in the case, and the jury returned a verdict which concluded as follows: "From the testimony we believe that said explosion might have been averted if the employes of the Chicago Gaslight & Coke company had exercised due care."

Controlling Currents on Electric Circuits.

The accompanying diagram illustrates a method of determining the difference of potential existing at a given point in an electric light and power system. When current is fed to points more or less distant from a central station supplying incandescent lamps in multiple, there is a fall of potential due to the resistance of the conductors, and as the current flowing increases, the fall of potential also increases, so that if it is desired to maintain a constant difference of potential at the distant points special



CONTROLLING CURRENTS ON ELECTRIC CIRCUITS.

means must be employed for determining the loss under any given load.

To accomplish this John Hopkinson of England employs an indicator wound with two opposing coils, as shown. One of these coils is of comparatively high resistance, and is connected across the terminals of the dynamo. The other coil is of low resistance and is connected in the conductor, so as to be traversed by all or a determined proportional part of the current flowing to the lamps or motors. The increase in difference of potential required to compensate for the drop or loss is determined by properly adjusting the relative effects of the two coils of the indicator.

Brownlee Railway Poles.

The Brownlee electric railway poles shown in Figs. 1, 2, 3 and 4 are made of rolled Bessemer steel, with heavy malleable iron braces. Fig. 1 shows a pole for center construction with a heavy base of wrought iron pipe which guards the pole from injury from vehicles, etc., and at the same

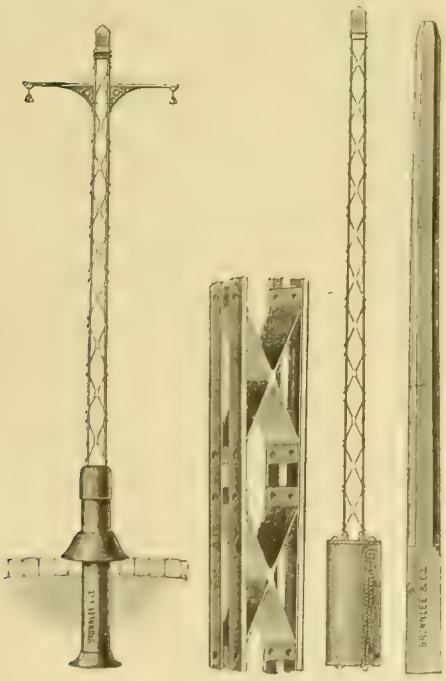


FIG. 1. FIG. 2. FIG. 3. FIG. 4.

BROWNLEE RAILWAY POLE.

time gives it rigidity. The section of the pole shown in Fig. 2 gives a clear idea of the manner in which the malleable iron braces are riveted to the steel framework. The braces gradually diminish in size from base to top. The arm for supporting the trolley wires is simple and strong. For side poles the manufacturers furnish a base made of Michigan cedar (Fig. 3) twelve inches in diameter. This gives a very large surface in the ground, thus holding the pole rigidly to place without cement and concrete setting. The main pole is fastened to the base by heavy bolts running entirely through the cedar foundation. Michigan cedar of this size, it is said, will last in the ground from twenty to twenty-five years.

The side poles are, however, made with the iron base when preferred. Another feature of these poles worthy of note is the arrangement contained in the cap, for straining the cross wires. This, it is claimed, does away with the usual extra expense for this attachment, while it also protects the mechanism from the weather. Fig. 4 shows a form of octagonal red pine pole for railway work. The poles are made by Brownlee & Co. of Detroit, Mich.

Alleged Infringement of Patents.

The Cowles Electric & Smelting Aluminum company of Lockport, N. Y., last week commenced suit in the United States Circuit Court against the Pittsburg Reduction company for damages for alleged infringement of four patents. The patents are on improvements in electric processes of smelting ore for the productions of alloys, bronzes and metallic compounds; an electric furnace and method of operating the same, and two improvements on the furnace. An injunction is also asked for to restrain the defendants from continuing the alleged infringement.

Chicago Board of Trade and the Telegraph.

President Baker of the Chicago Board of Trade, in his annual address revived the discussion on the proposed telegraph line connecting the great trade centers of the country, which is favored by the Chicago organization. This subject has been under consideration of a committee ever since the board refused to admit the Western Union operators to the floor. Robert Lindblom is a member of the committee of five appointed to formulate a scheme for carrying out this plan. He has given much attention to the subject, and is thoroughly convinced of its practicability. In speaking of the matter, he said:

"There should be no difficulty in making a success of this project. The only obstacles we are likely to encounter will be those thrown in our path by the old companies when we come to look for right of way into cities like New York and Chicago. We should build our first line between these cities. It would cost probably $1,000,000. Afterward it could be extended to St. Louis, Minneapolis, Toledo, Detroit and other points if the amount of business done required it." Mr. Lindblom said he believed the project would prove profitable: "I have figured it out that on the basis of the business annually done by the trade centers of the country such a line would pay for itself in ten years. At present a message of ten words from here to New York costs 40 cents. A little while ago it was sent for 25 cents. With our own line we need not charge more than 15 cents and still make money.

"Our first efforts will be to enlist the support of the New York Produce Exchange and Wall street. The stock of the company would be apportioned among the different exchanges with regard to the volume of business done in each of them. To prevent the company being absorbed by the Western Union a proviso would be inserted in our charter to prevent the sale of stock to outsiders without first offering it to the board of directors.

"We have now an independent line between here and Milwaukee which takes messages at 10 cents for ten words. It is called the Chicago and Milwaukee Telegraph company, and it is owned by members of the board of trade. It was built fifteen years ago at a cost of $16,000. The stock has since been watered to three times that amount, yet it pays annual dividends of 10 per cent. besides distributing rebates yearly to the stockholders using the wires. The Western Union lowered its tolls between these points to the 10-cent limit as the result of this competition. When we build our New York line look out for a return to the old 25-cent rate."

The Western Union is not at all disturbed over the threatened opposition. There have been so many failures in similar attempts that the present proposition is not expected to prove successful.

It should be added that the statement so often repeated by the Board of Trade men that the company raised the rate from 25 cents to 40 cents on New York messages, is not correct. A special rate was fixed for the board, 25 cents for ten words, while the company was permitted to do business on the floor, but as soon as the operators were refused admission all business was conducted through the regular offices and regular prices were charged as a matter of course.

Commercial Rating of Electric Generators.[1]

By Thomas G. Grier.

Good engineering requires that specifications should have their aims, objects and purposes defined with accuracy. The generator of an electric light or power plant is one of its most essential features, and in defining or in rating its capacity we should do so in terms that have a tangible meaning.

The standard electrical units by which electric light installations may be specified are the ohm, volt, ampere and candle power, and in electrical power installations substituting the horse power for the candle power.

Instruments for measuring the ohm, volt and ampere have been adapted to the necessities of practical engineering, and when these three units are the basis of a specification it is with comparative ease that an expert can ascertain the correctness of the work.

In the majority of specifications and contracts, as now drawn, the capacity of the wiring will be for so many 16-candle power lamps, or for so many horse power motors; and the generators will be rated in so many 16-candle power lamp capacity, or for so many horse power motors.

This use of the units, candle power and horse power, virtually means nothing.

The arc lamp of so many nominal candle power is another unit which means nothing when applied to the capacity of the machine.

The candle power unit is in a measure open for criticism on the point of accuracy, but in the discussion the discrepancies that may exist in the several standards are not the points to be considered. The candle power unit is a unit of light. Our generators do not produce light, but electrical energy. Our arc and incandescent lamps convert the electrical energy into heat and light. The horse power is the unit of power. Our generators do not produce the power, but our motors utilize the electrical energy and convert it.

Before considering why we should not use the terms candle power and horse power in rating our generators, even though these terms are perfectly correct, we will discuss the converting apparatus, that is, the incandescent lamp, the arc lamp and the motor.

The incandescent lamp being an apparatus for converting electrical energy into light with an unfortunate side product of heat, does not give back 100 per cent. of the electrical energy as light, nor does the proportion that produces light and the proportion that develops heat vary in the same ratio under different conditions Lamps are in use to day that vary in the consumption of energy per candle power produced from three to seven watts, and even as low as two watts has been claimed. This variation in the energy, when the lamps are of the same voltage, means a variation in the amount of current necessary to produce the equal amount of light. Recent experiments made upon lamps bought in the open market show conclusively that lamps of the same rated voltage and candle power are not uniform Here are a few instances of the variations of the amount of current required.

First, twenty lamps, ten each of two different makes, were placed upon urdinary commercial meters, and were burned for the same length of time. To eliminate the errors of the meters they were transposed so that each set burned an equal time on each meter. The result of the experiment showed that there was a difference of 27 per cent., in the amount of current consumed, between the sets.

Second. Another station tried the same experiment using one set of lamps of a different make from that of the former, and one set of the same make. The result of their experiment was a difference of 22 per cent.

Third. A station operating some 700 lights had a number of the nominal 16-candle power lamps that were in use, tested, and found the candle power to range from 17 to 22 candle power. On discovering this, nominal 10-candle power lamps were used and called 16-candle power. As the current was sold by meter, the customer was in no way injured by the substitution.

Fourth. A number of large lamps were tested, and nominal 100-candle power lamps were found to give from 44-candle power up to 110-candle power.

Fifth. In December, 1890, tests were made on four different makes of lamps. All the lamps were marked, by the manufacturers, at the same voltage, and all were nominal 16-candle power lamps. The tests showed a variety of candle powers ranging from 11 up to 24, and efficiencies from 2.46 watts to 4 watts per candle power.

Sixth. A large lamp of new make of nominal 150-candle power gave an efficiency of 2.4 watts per candle power. As this was the most efficient of any lamp tested it has been placed on the circuit of a central station, and is undergoing a life test.

These experiments are of considerable value in this paper as proofs of the desired end in view, as they show that when capacity is given in candle power it means only an approximation. We, however, should not draw conclusions as to the real commercial value of the lamps tested.

The durability of a lamp is a most important factor, and without a test as to the life of the various lamps and a mathematical equation being deduced that would include life, efficiency and cost of lamp, no actual commercial conclusion should be drawn. It is a well known fact that the life of a lamp is dependent upon the efficiency at which it is used. A lamp can be made to produce light commercially at an expenditure of energy varying from 2 to 7 watts per candle power.

The factors that govern the efficiency at which the lamp

[1] Read before the Chicago Electric Club, January 6, 1891.

should be run are, the cost of producing the electrical energy, and the cost of the lamps.

From this view of the matter, even though the lamps were uniform, it is possible to have conditions wherein would exist a difference of over 100 per cent. in the amount of current necessary to produce equal amounts of light.

When a specification requires that an incandescent dynamo should have a capacity of 100 16 candle power lamps at 110 volts, what does it mean? Must the machine be capable of producing energy sufficient to operate lamps at 7 watts, or but 2 watts per candle power.

Must it develop 30 amperes, or about 102 amperes? Either machine being within the range of the specification, the efficiency of the lamps entirely governing the size. If nothing further than the capacity in candle power is specified what right would the purchaser have to grievance or redress if the machine of the smallest limit (that is 30 amperes) were sold to him as a 100 light machine, his lamps requiring more amperes than 30?

The arc lamp is also an apparatus which converts our electrical energy into light and heat. Its efficiency when well adjusted and carefully cared for, should not vary to any great extent. Bad adjustment is a baneful cause of poor efficiency, and good adjustment cannot be maintained without good regulation. To measure the candle power of an arc lamp is not the easiest matter in the world, and for one to attempt to judge by the eye is an absurdity.

In tests that have been made on arc lamps, the results were from 7-10 of a horse power up to 1 4-10 horse power per lamp of 2,000-candle power, so-called. These figures were based upon the difference between the total horse power exerted by the engine, and the horse power of the engine running empty and the belt thrown off the dynamo.

As the actual candle power of the lamp could not be measured it remains still a matter of conjecture whether the machines were really of so many 2,000-candle power lamp capacity.

The motor is another apparatus for transforming electrical energy into different forms. The efficiencies of the various motors on the market vary from 90 odd per cent. to as low as 50 per cent, and perhaps lower. Their efficiency also varies with their speed and load.

The generator for a 10-horse power motor could mean a machine capable of generating anywhere from 11-horse power up to 20, depending entirely upon the economy with which the electric motor would utilize the energy supplied by the generator.

The question of rating the machines in the units which measure the work of another piece of apparatus is merely rating the machine upon a variable standard, that is, the efficiency of another machine. We do not rate our engines in the capacity of the dynamo, but upon a unit of its own—the horse power, giving the speed and pressure at which this horse power is developed.

The boilers, however, are frequently rated in the unit horse power, which unfortunately is as great a mistake as the rating of dynamos or generators in any other unit than that of the form of energy which is directly produced by them.

The transformation, or the conversion, of any form of energy to another must take into consideration the efficiency of the converting apparatus.

In transmitting energy from the point of production to the point of consumption, a loss is entailed. To convey electrical energy for light and power we use a metal conductor. The size of this conductor is not dependent upon the amount of horse power developed or the amount of candle power developed, but upon the amount of current transmitted, and the amount of pressure behind it. It is within the limits of possibilities wherein the current to develop the same amount of light or power may be double in one case what it would in another, owing to the difference in efficiency of the converting apparatus.

Another point to consider besides the efficiency is the resistance in the conductors. In some cases where fuel is extremely cheap, a large percentage of the energy may be used in transmitting the power, and consequently the generator would have to have an increase added to its capacity in proportion to this percentage that is lost. Tables for the use of wiremen have been prepared by the various companies, and while speaking of the generator it is just as well that attention should be called to the tables. Units used as a basis for their determination are the horse power and the 16-candle power lamp. It is apparent that a wire to carry a 16-candle power lamp or a horse power with a certain per cent. loss, does not even mean an approximation, the variable conditions that exist giving the expression only a very general meaning. The lamps or horse power are assumed to take a certain amount of current and, though the calculations are correct, the entire table depends for its accuracy upon how near the assumption approaches the actual efficiency of the apparatus used.

The capacity of the generators should be specified in the units that measure the energy in the form in which it is developed. Dynamo electric machines develop or produce electrical energy measured in volts and amperes. The carrying capacity of wires for the transmission of this energy depends upon volts and amperes. The candle power and horse power have naught to do with it. Electrical generators should have their capacity specified in volts and amperes or in watts giving the pressure in volts at which this specified power is produced. The size of the wires should be determined upon the basis of amperes and volts, stating the percentage or number of volts lost in transmitting the current.

The English manufacturers give the capacity of the dynamo in watts, and a purchaser, even if he be ignorant of the first principles of electric machinery, could with little trouble, find whether he had received the capacity that he had paid for. But had the rating been in candle power or horse power the result could not have been so satisfactory.

The Edison company in the United States and several others of the larger electric manufacturing companies have given the capacity of their various generators in watts, but the agents and contractors seem invariably to overlook this, and propositions and contracts are drawn up with the generators rated in the indefinite terms, horse power and lamps or candle power.

Why the Americans have adopted the candle power and the horse power as a basis of rating electrical machinery and the compiling of wiring tables, is, perhaps, apparent to many; and the reasons were, no doubt, at one time good. It is, however, obvious that this general use of these technical terms is entirely wrong and the electrician must be the means of reorganizing the system. The tendencies are in the direction of this needed reformation, but the change cannot be too rapid nor too soon.

The fundamental principles of Ohm's law are thoroughly familiar to the intelligent workman, and the sooner our calculations are confined to its mathematical accuracy and our generating machinery rated in the proper units, the better for the electrical business.

The Rise of Potential Difference in the Deptford Mains.[1]

By W. E. Ayrton.

I am glad to see, from Mr. Glazebrook's article in the *Electrician* for December 26, that he holds the same view as that given by me to my students some little while ago on this subject. This view was, that when a transformer is used at Deptford to transform up the volts and another one at London to transform them down, the mere fact that the cable connecting these transformers had capacity was sufficient to cause the potential difference at London to be higher than the potential difference at Deptford. In connection with this suggestion some of the students at the Central Institution made a number of experiments last term under the superintendence of Dr. Sumpner and Mr. Mather. The annexed figure explains the arrangement

of apparatus used by them for one set of tests, and with a certain rate of alternation, etc., they found on pressing down the double key, K, by its wooden cross-bar so as to connect the two coatings of the condenser with the two terminals of the secondary coil of the transformer, that while the potential difference measured by voltmeter E_1V (volts at Deptford) went up to about 1 per cent., the potential difference measured by the voltmeter E_2V (volts at London) went up over 5 per cent On raising the key, the potential difference at each end of the circuit went back to its original value, showing that the effect observed in this experiment was solely due to the addition of capacity to the mains.

As the secretaries of the Physical Society tell me that they intend devoting one meeting early this next year *exclusively* to the subject of transformers, I will confine myself on the present occasion to the above brief description of this one experiment.

[1] London Electrician

Rapid Transit for New York City.

The public meeting of the Rapid Transit commission of New York city was attended by many engineers and promotors of schemes, but it is agreed that interest was centered in the proposition to establish an underground system operated by electricity after the plan of the City and South London railroad. Louis Stern of London, representing the Greathead system of underground electric railroad, which is now in operation in the English metropolis, gave a description of the road, and of the novel engineering methods employed in its construction, methods, he said, which rendered the underground system peculiarly adaptable to the rapid transit requirements of New York city.

Mr. Stern said the ventilation of the tunnel was perfect, the air was as sweet and pure as the upper atmosphere, the coaches were made light as day by electric lights, and the temperature of the tunnel varied only between 54 and 60 degrees. To meet the requirements of New York city he would suggest that tunnels of eleven or perhaps twelve feet in diameter be constructed, that trains consist of five or more coaches, and that to move trains, capable of carrying from a thousand to twelve hundred passengers, sufficient current be provided.

The commissioners were better judges than he of the ideal routes through New York city and of the general requirements of the city, but he understood that there was a general consensus of opinion that Broadway, for a certain distance, at least, was one of these ideal routes. Any objection, he said, that there might be to the use of Broadway for either an arcade, an elevated, or a viaduct railroad, could not possibly attach to the deep underground scheme. Four or six tunnels could be run through the line of Broadway from Bowling Green or South Ferry, without the least possible injury to the foundations of encroachments upon the vault privileges of property owners along the thoroughfare. From the stations access would be had to the railroad platforms by elevators capable of carrying fifty or sixty people, and by supplementary stairways. Any desired speed could be maintained. For through traffic the trip ought to be made from Wall street to 125th street within fifteen minutes at the outside. Considering the value of property, which would be necessary for any convenient line of surface, viaduct, or elevated railroad, the underground railroad system was the cheapest. A hasty computation of the probable cost of an underground railroad system in New York city assured Mr. Stern, that a double tunnel system could be constructed for less than $1,000,000 a mile, and a four-track system—if constructed at the same time—for less than $1,800,000 a mile, including equipment and organization. Such a system of railroad for New York city could be more speedily constructed than any other, and when completed, would give to the city a greater measure of relief from the present overcrowded condition of its surface and elevated railroad lines, and would assist more materially in the development of the unsettled sections of the city than any other system. Although the time allowed Mr. Stern was limited, he gave an excellent idea of the possibilities of a Broadway tunnel.

Where the tunnel runs through hard pan, gravel, sand, or dry earth the work is very simple, and rapid progress can be made. At one time, he said, the contractors on the City and South London railroad were doing more than 100 feet of tunnel daily, and in one-half year did two and one-quarter miles. This, there was every reason to suppose, would be the rate of tunneling possible for that section of New York city south of about Fourteenth street, with the exception of the ancient water course at Canal street.

For sections impregnated by water, such as this Canal street section would be, there was constructed within the shield two bulkheads of steel, with valvular trap doors. Into the forward and middle chambers formed by these bulkheads the pressure of air of about fifteen pounds was forced, enabling workmen to excavate with safety and comfort. As fast as a section of twenty inches is completed the shield is urged forward by the hydraulic jacks for another section of twenty inches, the jacks are removed and another segmental ring of the tunnel is put in place, and is bolted and riveted.

Mr. Stern concluded by elaborating upon the possibilities opened up by the application of electricity to work of this kind. He said the tunnels offer ideal advantages for the use of this motive power.

Robert R. Hazard appeared for the New York Underground railroad, and asked that its engineers be heard at a subsequent meeting, That concern, he said, was a relic of the past, but it hoped to see its route and plan adopted, namely, an underground electric road under Broadway.

Electrical engineers and exploiters seem to thoroughly appreciate the opportunity afforded them. Thomas Edison says: "In a word, I favor the London plan. It is almost absolute perfection. It becomes simple in view of the progress of the science of engineering, and a quarter of a century hence our rapid transit commissioners, if there be any of them, will wonder why those in power to-day had not thought of the whole business a whole century before, just as we wonder why our ancestors did not utilize steam and electricity." Edward H. Johnson, president of the Interior Conduit & Insulation company, says: 'I stake my reputation upon the assertion that it is now as feasible to operate the elevated railway, and, therefore, an underground railway by electricity as to operate the 8,000 street cars that are now being operated in the United States by electricity. I claim respect for my opinion on this subject as I was the pioneer in the industry which now operates these 8,000 cars." Franklin L. Pope says in regard to the electric underground system that the "first great recommendation of the underground system for this city is its relative simplicity" Leo Daft says: "In the light of the work already accomplished on the English road, and with our much wider experience of electric traction, it seems that the risk of such a change ought to be minimized." L. W. Serrell advocates electricity for the elevated structures as an immediate relief.

Westinghouse Electric & Manufacturing Company.

All sorts of rumors concerning the Westinghouse Electric & Manufacturing company were in circulation last week. It was generally known some time ago that the company needed money to meet pressing obligations. The fact that the company was doing so extensive a business produced a general belief that it would not be seriously embarrassed. Over two weeks ago it was announced that a number of Pittsburg banks had decided to raise a fund of $500,000 to tide the company over its difficulties. An advisory board was appointed to manage the Westinghouse interests until all danger of failure was past. On January 14 the board met and decided to return the $500,000 to the persons who contributed it, on the ground that it was not sufficient to acomplish what it was raised for.

This action naturally tended to create additional rumors about the embarrassment of the corporation. Mr. Westinghouse was seen at this time in New York City and expressed the belief that the company would secure what money it needed by the disposal of $3,000,000 preferred stock. Mr Westinghouse returned to Pittsburg on Friday, and made this statement in the local papers:

"Concerning the placing of the preferred stock of the Westinghouse Electric company, I can only say this at present: A subscription for four thousand shares has been made by one interest. Negotiations are well advanced for a block of twelve thousand five hundred more, both conditioned upon a total of thirty thousand shares being taken, and I can answer for another four thousand shares. If the creditors join the preferred stock movement, as some have indicated they will, and the stockholders and others to be benefited take an immediate and active interest, there is no reason why the retirement of the advisory board should have more than a momentary effect. Some of the subscribers to the fund have already promised to take preferred stock to the amount of their subscription."

A meeting of creditors of the Westinghouse

company met in Pittsburg on Saturday last. Charles A. Wolfe, secretary, read the report of the committee instructed to visit the Westinghouse building and secure a statement of the indebtedness of the company. There, the report said, the committee was received by Vice-President Bannister, who treated the members with the utmost courtesy, and did all in his power to further their work. Mr. Bannister, in his conversation with the committee, said that matters were looking much brighter just at present, and if the creditors follow out the policy laid down by the committee the business can soon be placed on a paying basis. At present, said Mr. Bannister, the business is large in volume and profit and it can and will be carried on on a basis to guarantee success. The banks are amply secured and preferred stock accepted by the creditors will be good, as it has the first chance at the assets of the company.

W. B. McLean made this statement:

"At present the Westinghouse Electric & Manufacturing company is doing a business of $15,000 daily, and that without agents out. See what an immense business that is and what it can be made after this trouble is over. See how great a benefit it is to Pittsburg to keep it here. Mr. Bannister assured the committee that with proper management it would be worth $600,000 profit per year to the stockholders. It would certainly be a great pity to allow this concern to leave Pittsburg, and I don't believe anybody here wants to see that occur. This committee was appointed and this meeting of creditors called to take action that will prove profitable to all concerned. Now, we have a paper to present, which I hope you will favorably consider, as it is of great importance to all present and to the entire city of Pittsburg."

Secretary Wolfe read the heading of the agreement to take preferred stock in lieu of cash, as follows: "We, the undersigned creditors of the Westinghouse Electric & Manufacturing company, agree to accept preferred stock at the par value of $50 per share to the amount set opposite our names, on the condition that $1,500,000 be subscribed before February 3, 1891, the amounts to be entered as credits on the several accounts." Mr. Wolfe said an effort would be made to induce all the creditors to sign the agreement. A motion that all present sign the agreement was made, in order that a general discussion might ensue. All those present expressed a willingness to aid the company in any way.

H. Mc. L. Harding addressed the meeting as follows:

There is an immense profit in the electric business, and there are only three companies in the United States—the Westinghouse, Thomson-Houston and Edison. These companies cannot produce work fast enough. The Pittsburg shops can be worked night and day and not keep ahead of orders. At present we have a contract for 34 dynamos for a Boston company, and there are $3,000,000 worth of other contracts that we are bidding for.

It is impossible to calculate the immensity of this business, and with proper care and management it will become a good paying investment. Mining is opening a vast field for work by electricity, and from every direction orders are coming for improved electrical mining machinery. It has been charged that the business was poorly managed and that machinery was sold on long time to irresponsible parties. Everything is sold on short time, and the street car companies, who are the main purchasers, are composed of good, substantial men.

"One cause of the present embarrassment," continued Mr. Harding, "was the swallowing up of the small companies. When a company was absorbed the officers would remain with it, causing a big expense. Mr. Westinghouse later on investigated this matter, and when he saw how it was being done demanded a wholesale list of resignations. By this and other economic measures the expenses of the company have been reduced at the rate of $600,000 annually.

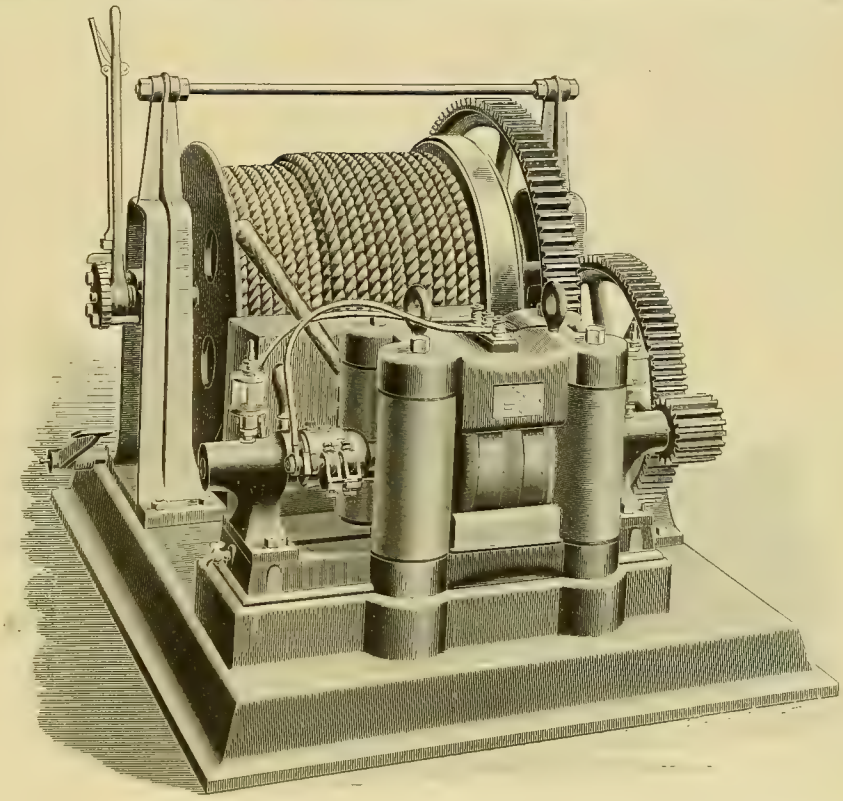
"The other big electric companies, the Thomson-Houston and Edison, had this same trouble. The only difference was that they saw it ahead and issued preferred stock. About a year ago the Edison took this measure of tiding over and the other company deferred action until about four months ago. The one issued $8,000,000 and the other about $3,000,000 of preferred stock. The former company has just begun to call in its paper. Had the Westinghouse company seen ahead and issued its preferred stock before the crisis came, all the trouble would have been avoided and no one would have known how hard it was to get money and come out all right But everything is looking better, and I believe when the financial men understand the exact state of affairs, they will gladly come forward with the money needed."

At the conclusion of Mr. Harding's remarks those present were given an opportunity to sign the paper accepting the preferred stock. The majority did so, and those who did not said that they would be compelled to consult other members of the firms they represented. The stock taken amounted to about $65,000.

The Detroit Motor Company's New Hoist.

The general design of an electrical hoist recently placed on the market by the Detroit Motor company of Detroit, Mich., is illustrated in the cut. This machine is made in two sizes, 5-horse power and 10-horse power respectively.

These hoists are so designed that the levers for operating the friction clutch, switch and brake are brought into such a position to the operator that he may not, to operate any one of them, have to change his position. A stout bar connects the two bearing stands at the top. This construction is to prevent any springing apart of the stands when the friction clutch is forced into place. All parts are substantially made. The motor is provided with a rawhide pinion, and all the gears are cut to a standard.



ELECTRIC HOIST.

The switch and resistance box for regulating the speed are fastened to the iron bed-plate.

American Inventors to Form an Association.

It is proposed to form an association of American inventors and at the same time celebrate the beginning of the second century of the American patent system. Those interested in the project have issued the following circular:

The completion of the first century of the American patent system marks so important an epoch in the history of the Nation that it is eminently proper that the beginning of the second shall not pass unnoticed.

The centennial anniversaries of other important national events have been celebrated in a manner worthy of a people proud of their country and its growth. Surely the system that has aided the agriculturist in the field, the mechanic in the shop, and the toiler in the mine; that has stimulated invention and helped every branch of modern industry has played no small part in a history so full of the triumphs of human achievement.

Believing that the American inventor and manufacturer of inventions will regard it a privilege as well as a duty to co-operate in making due recognition of these facts, it is proposed to hold a celebration at the National Capital in April, 1891, which shall in a fitting manner commemorate the important event, and place on record the Nation's appreciation of the labors of those whose ingenuity, patience and tireless efforts, have exercised such a potent influence in accelerating the prosperous growth of the Nation, and in aiding the progress of our civilization.

The necessity for a National Association of Inventors organized for mutual benefit has been frequently discussed in the technical and other journals. No time could be more opportune for the formation of such an Association than when men from every part of the country meet to celebrate so important an anniversary. Surely the occasion is most inspiring!

All inventors and manufacturers and others interested are requested to co-operate with this committee in the purpose above set forth. Correspondence appertaining thereto should be addressed to J. Elfreth Watkins, secretary U. S. National Museum, Washington, D. C.

Ford-Washburn Storage Battery.

Early in 1889 George A. Washburn of Cleveland, O., began experimenting with a new form of storage battery. His work has just resulted in the design of an accumulator which will soon be placed on the market. The following description of the battery has been furnished the WESTERN ELECTRICIAN: The inventor did not attempt to design new forms of apertures or pockets for holding the active material in place, but devised a novel construction by which it is claimed the active material is so confined that it cannot leave its chambers. It is claimed that in accordance with his method of making plates, the weight has been reduced at least 33 per cent. for the same capacity.

Three experts were recently invited to subject the battery to every test possible which would aid in ascertaining its value for commercial purposes. They proceeded on two lines. First, to ascertain the storage capacity of the battery, and second, its durability or destructibility.

The test for storage capacity, it is claimed, shows that the output of the battery was about double that claimed by the constructors of other batteries.

The test for durability or destructibility of the battery was direct short circuiting of the cell. It withstood this excessive strain, it is asserted, for seven consecutive hours the first day, and three and a half the second day, until, as the report stated, it was exhausted, and without being impaired or injured in the slightest degree. A company composed of Lester A. Cobb, William H. Marshall and George Hoyt will be incorporated under the name of the Ford-Washburn Storage Battery company to handle the battery. A factory will be built at once.

CORRESPONDENCE.

New York Notes.

NEW YORK, Jan. 17.—The course of evening lectures on electricity at Columbia College was begun this week. Tickets for the whole number of seats, 92, were sold, and there were twenty more applicants. This result is remarkable considering that there was little or no advertising. President Low bought a ticket, and several other officers and professors of the college secured seats for the season.

The next regular meeting of the Electric Club will be held Thursday evening, when Franklin Leonard Pope will address the members on "Notes on the Electric Railway, Historical, Statistical and Technical." The timely subject will make the lecture of widespread interest.

The litigation which has been going on for some time between Leo Daft and the United Electric Traction company, and the Daft Electric Light company, is very near a settlement. At the office of the companies it was said that the suit had been withdrawn, but counsel for Mr. Daft said that the announcement was a trifle premature as there were still some more points of difference to be adjusted. The United Electric Traction company took steps to acquire control of the Daft Electric Light company and other properties. Mr. Daft, as a stockholder in the company which bore his name, objected to the transfer as against his interests. Subsequently, when the traction

company prepared for an issue of $700,000 in bonds, partly to pay liabilities incurred in taking in the smaller concerns, Mr. Daft secured a temporary injunction from Judge Patterson of the Supreme Court forbidding the bond issue and the exchange of stock of the corporations. He alleged that the trustees of the Daft company were not empowered to make the transfer. Now, apparently, the case is said to be in a fair way to be settled speedily.

Capt. John Ericsson, the inventor, made in his will specific bequests of $125,000, but it turns out that his estate does not exceed $90,000, and the executors, George H. Robinson and C. S. Bushnell, have begun a suit in the Supreme Court for a judicial construction of the will. The question they present is whether any legacy shall have preference.

A Western Union lineman discovered a "tap" in the Clifton race track wire opposite 529 Sixth avenue a couple of days ago, and at once notified the police. Officers went to the spot and in a room on the top floor of a building found three telegraphers named Fred Marron, Edward Mureen and Charles H. Flint. They had tapped the race wire last Monday, and since then had delayed the results of the Clifton races until they had made wagers on the event at Barney Michael's place on West Thirty-third street. Their winnings, however, did not amount to a great deal.

The sudden cessation in the demand for copper has caused surprise. A few months ago the consumption exceeded the supply, and about 60 per cent. of this demand came from the electrical industries. This was checked by the recent financial storm, but with an easy money market the former big demand for copper is expected to return.

The Court of Appeals at Albany has affirmed the judgments of conviction in the cases of three murderers—James Slocum, Harris A. Smiler and Frank Fish—all of whom are under sentence of death, according to the new law. In the meantime the position taken by Attorney Sherman continues to be discussed in legal circles.

A horse belonging to Expressman Leonard White was backed up at the stage door of Miner's Theater, in Beaver street, Newark, this afternoon, when an electric light wire, overloaded with ice, fell upon its back. The animal died instantly.

A number of telephones were burned out in Newark a few days ago by contact with light wires, and several small fires were started, but quickly extinguished.

The storm interfered considerably to-day with telegraphic communications south. The weight of ice on the wires broke them down, and delayed communication with Philadelphia, Wilmington, Baltimore and points south. There were no breaks in the wires north, west and southwest. A Western Union official said: "It is fortunate for us that we have most of our city wires underground. Before we buried them a storm like this used to paralyze us for two or three days. If we had them overground to-day we would probably be in a bad way, so far as city communication is concerned. As it is we are practically unhurt."

W. H. T.

Minneapolis, Minn.

MINNEAPOLIS, Minn., Jan. 17.—At the annual meeting of the St. Paul City Railway company, last Thursday, Thomas Lowry was re-elected president, and C. P. Goodrich vice-president. A. J. Levering was elected secretary, and Hon. Wm. P. Merriam, governor of Minnesota, treasurer. The board of directors for the current year will be composed of Messrs. Lowry and Goodrich, Thomas C. Wilson, A. L. Scott and Col. Charles Sanborn. There is practically no change in officers, and the policy of the company in electrical construction will be continued as outlined last year.

The Minneapolis Street Railway company has determined upon the construction of an electric line to St. Louis Park, a western manufacturing suburb, which will add about ten miles of track to the already extensive Minneapolis system. If the present plan is carried out this line will run on Hennepin avenue to Lake street, and thence directly through the property of the St. Louis Park syndicate, which is rapidly developing with important manufactures. This is in the direction of Lake Minnetonka, Minneapolis' principal summer resort, and the probabilities are that the Minnetonka line already projected will follow the same route to St. Louis Park.

The second 1,200 horse power engine for the main power house of the street railway company has been shipped from the Allis works at Milwaukee. The third engine, which will complete its equipment, will be built during the winter. The Minneapolis company has arranged to manufacture its own switches and trolley wheels from patterns furnished by Wm. Driscoll, master mechanic. Pres. Lowry is now in the East purchasing material, and active construction will be resumed as soon as the frost is out of the ground in the spring.

J. D. Owens, agent for the Darche Electric company in this city, was robbed by highwaymen Monday night at the entrance of the building in which his office is situated. The robbers secured $18 in cash, and other valuables.

The Mankato (Minn.) Electric Lighting company has put its new arc lighting plant into operation, and has commenced to light the streets of the city.

The Lake Superior Electrical Contracting company has been formed at Marquette, Mich., with a capital of $200,000.

The West St. Paul line has been opened, and cars are now running regularly on the Robert street bridge over the Mississippi.

N. O. F.

Kansas City, Mo.

KANSAS CITY, MO., Jan. 17.—The Western Union Telegraph company handled on an average about 15 000 messages a day in Kansas City during the year 1890. It has thirty branch offices here. The business of the company greatly increased in 1890. It took about $13,000 a month to pay the expenses of conducting the company's business here in 1889. Last year it averaged about $17,000 a month. The number of employes is about 275. Ninety men and sixty-five women are employed as operators. There are sixty-five messengers.

The business of the Postal Telegraph company increased 40 per cent. in 1890.

The Missouri & Kansas Telephone company has now 2,561 instruments in use here, and has thirty-three exchanges and many toll stations outside. It employs about 100 persons in this city, sixty of whom are operators at the boards. Its outlay in 1890 in Kansas City was about $100,000, besides royalties amounting to $40,000. During the past year quarterly dividends of 1 per cent. were paid. Copper wires were substituted for iron ones in the city during the year.

During 1890 the Kansas City Electric Light company added about thirty miles of circuit to its street system. The company now has about 200 miles of street system It is supplying 750 arc and 1,500 incandescent lights. Its capacity is 1,000 arc and 2 000 incandescent.

The Edison Electric Light & Power company spent about $40,000 in improvements during 1890. This concern has a capacity of 10,000 lamps, and is supplying about 8,000.

The Sperry Associate Electric company extended its street system for incandescent lights in the southern part of the city. It has 3,000 lamps' capacity.

The American Electric Light company is contemplating considerable improvement for 1891. It maintains about 250 arc and about 300 incandescent lights. Its plant is located at the corner of Twentieth and Central streets.

The Western Union officials of this division visited the city recently and made an inspection of the offices. The most important news to Kansas City is the announcement that the business here has grown to such proportions that it will be necessary to enlarge the present general offices on Fifth street.

The Missouri & Kansas Telephone company has recently been urged to establish a telephone between Kansas City and St. Louis. The telephone management has come to the conclusion that the business of such a line would not be sufficient to warrant the expense.

The Bernheimer Bros. of this city have received a letter from their brother-in-law, Samuel Lesem of Denver, who has just returned from a two months' trip to the City of Mexico. Mr. Lesem writes that while there he obtained the exclusive franchise for operating electric motors in that city, and for the establishment of an electric street railway system. His franchise covers fifty years, all told, twelve years' exclusive privilege and fifteen years free from all impost duties and taxes, except stamp tax.

Mr. Lesem says that his company expects to lay 250 miles of track for the street railways, and that they will spend at least fifteen millions in building the entire electric system in and about the city.

The construction of the electric plant will begin within six months. Mr. Lesem expects to visit his relatives in Kansas City, and make a personal inspection of the rapid transit system here before returning to Mexico.

The Missouri, Kansas & Texas Trust company will apply to the council for a franchise to construct an electric line from the Second Street Belt Line depot at Second and Wyandotte streets, south on Wyandotte to Seventeenth or Twentieth, and thence east to Vine, where it will connect with the Ivanhoe Park electric line, which the Missouri, Kansas & Texas company now practically controls.

In connection with this line it is hoped to extend the People's Cable railway west on Tenth street to Wyandotte, and have it drop a trail car there, which may be conveyed by the electric line north to the Second Street Belt Line depot and return. The capital stock for this enterprise is to be $225,000, fully paid.

The building of the electric line will begin as soon as the franchise is secured. The men who are back of the enterprise are E. L. Martin, Arthur E. Stillwell, L. R. Moore, Hammett & Davison, and W. S. Taylor of this city; George Trautman, Wm. Watteral, Wm. Lucas and Samuel R. Shipley of Philadelphia; James Merwin of New Haven, Conn.; and Edgar R. Bronson of New York.

Eight weeks ago H. A. Davis, Jr., an electrician, left Pueblo, Colo., in company with C. B. Rodgers, for Cincinnati, to put up a plant for Russell, Morgan & Co. On reaching Kansas City Davis left the train, saying to Rodgers that he would return in a few minutes. From that time nothing has been heard of him by his brother in Pueblo, or by his parent, who reside in Wichita. He had a considerable sum of money, and it is feared he was foully dealt with in Kansas City. Davis is of good family, and is sober and industrious.

P.

Louisville, Ky.

LOUISVILLE, Jan. 17.—The Electric Street Car company at Chattanooga, Tenn., while building an extension of its suburban line, was enjoined by a mortgage obtained by the Cincinnati Southern Railroad company, restraining it from crossing its tracks. The Federal Court made the injunction perpetual on the ground that Harrison avenue, the road on which the electric line was located, had never been formally opened by the county.

The County court now has taken a hand in the matter. It directs the Cincinnati Southern to provide for the crossing of its line under penalty of vacating such portions of its track as pass over the extension of Harrison avenue. The end is not yet.

It is said that the Ohio Falls Street Railway company at Jeffersonville, Ind., will extend its tracks north to the Walnut Hills Cemetery in the spring. Electricity will also be substituted for mule power.

The question whether Madisonville, Ky., should appropriate $10,000 for an electric light plant was decided in the negative last Tuesday by only one vote. The election is said to have been the most exciting ever held there. There was some lively electioneering by men who hoped to get the contract.

At the last meeting of the Louisville General Council, Dr. Moody read from a proposed amendment to the constitution of the state, which gives to any person the right to construct telegraph or telephone lines with a view to create competition. Dr. Moody opposed such an amendment to the present state constitution on the ground that the city should have control of its own streets. He introduced a resolution, which was adopted, to the effect that such an amendment was inimical to the city's interests, and a copy of the resolution was sent to the delegates to the constitutional convention now in session at Frankfort.

J. W. L.

Milwaukee, Wis.

MILWAUKEE, Jan. 17.—Charles F. Pfister, the young millionaire and his associates, will build about thirty miles of single track electric railroad during the coming season. The Pfister company is showing its good faith by standing half of the expense of building a fine new bridge across the Milwaukee river at North avenue, along which thoroughfare the company will build to the western city limits. The other lines are to run the length of the East side, and to run to both the southeastern and southwestern parts of the South side. It is not known what system will be used. The Villard syndicate, which is interested in the Edison overhead system, owns the street railways into whose business the Pfister company would naturally cut, and has been fighting the new enterprise, both in and out of the courts from the very start. The company is undecided whether to lay the rails, put up the poles, and do the rest of the work by the day, or award contracts for the job.

It seems to be certain that another of the Wauwatosa electric railway schemes will materialize in the near future. At a conference of property owners interested in the construction of the Milwaukee & Wauwatosa Rapid Transit Railway, Capt. Pabst was present, and agreed to build the road. The line will follow Vliet street pretty closely all the way from the city to Wauwatosa. The road will cost something like $50,000. Arrangements are to be made as soon as possible to secure city terminals, and the line will probably connect with the Hinsey railroad. It will make the second road between the city and Wauwatosa.

A number of electricians have joined the Polytechnic society, which completed its organization on Monday evening. The objects of the society are to further technical science, promote social intercourse and maintain a library. Membership is restricted to persons engaged in architecture, chemistry, geology and mineralogy, and to civil, military, electrical, mining, hydraulic, sanitary, mechanical and marine engineers. The society starts out with nearly

100 members. It will meet at present in the rooms of the Wisconsin Electric club, into which it may possibly be merged. Meeting will be held the second Monday of each month. Donations of valuable books have already been promised, and it is hoped to accumulate a fine scientific library.

There has been a great deal of speculation for some time concerning the ownership of the West Side railway, Milwaukee's pioneer electric line. Washington Becker was for years the sole owner, but when the line was transformed into an electric system last spring, it became noised about that he had parted with a controlling interest. Later, it was rumored that Villard had acquired the control. Becker denied all these stories. Recent occurrences, however, show that Becker is far from being the sole owner of the road. In a suit to recover damages for injuries that a small boy received by being run over by one of the company's cars, the allegation is made that Francis W. Kennedy of Philadelphia, is the owner of a half interest.

Next spring the electric lines and other street railways will have a rival in a line of carettes, similar to those in Chicago, which George Hiles is preparing to establish. The carettes will run on Grand avenue and Prospect avenue, and perhaps on the South side. The enterprise is the direct outcome of a lack of conductors on the Cream City's Farwell avenue line, which Mr. Hiles patronizes. Mr. Hiles once fell down while making his way through a crowded car to the fare box, and he at once began to figure upon the establishment of carette lines.

Some interest is manifested in an announcement that a Milwaukee man has invented a steam street car which is likely to revolutionize traffic on the streets, according to some accounts. The machinery on the car, it is said, can neither be seen nor heard; there is no smoke, and the car runs along silently and mysteriously. Nothing is known about the invention. Milwaukee street car companies, in the meantime, are going ahead with electrical equipments.

C.

Pittsburg, Pa.

PITTSBURG, Jan. 15 —The stockholders of the Pittsburg, Allegheny & Manchester Traction company held a meeting a few days ago and decided to increase the capital stock of the company to $1,300,000. The additional capital is required by the corporation for the purpose of changing the motive power of the road. The company is one of the most important street car companies in Pittsburg. The company has already commenced to convert its lines into an electric system, and the management expects to have the electric cars running within a few months.

The Monon Electric Light & Power company of Homestead, Pa , has received a charter and the company will immediately establish an electric light plant with a capital of $10,000.

Two electric corporations in Uniontown, Pa., the Heat & Light company and the Electric Light and Power company, have consolidated under a New Jersey charter and the new name of the consolidated concern will be the United Light company.

The Second Avenue Electric Street Railway company of this city has just contracted for four new cars to increase its equipment in order to accommodate its patrons. This is an excellent evidence of the profit in changing from animal power to electric motors. When this company operated a street car line with horses, it only ran eight cars and lost money all the time, while twenty cars are not able to do all the business of the road to-day.

The Birmingham Traction company will commence the operation of its road by electricity within two weeks. A test of the machinery in the power house was made yesterday and it proved to be highly successful. The new cars have also arrived here and it will only be necessary now to equip the trucks after which the cars will commence to be run. It is said that the cars to be used on this road are the finest in Pittsburg. They are thirty-three feet long, closed in the front and rear, and the furnishing inside is stated to be highly finished and very elegant.

The municipal authorities of this city have for a long time considered the advisability of taxing all street car companies of Pittsburg. The latest step with this end in view was taken a few days ago by City Controller Morrow in sending circulars to the authorities of all the larger cities of this country asking the following questions:

Does your city receive any revenue from electric, cable or horse car lines? If so, is it a percentage on earnings? Or a license on cars? Or a tax on capital? How much, or at what rate respectively? If convenient, please give amount received last year?

When the controller has received sufficient replies to serve him as an estimate of the whole, he will frame an ordinance to be submitted to councils; and from the answers that have come in so far, it appears that councils will be asked to make the local companies pay.

The fire commission of Allegheny City met last night in order to elect a successor to the late Mr. Winn, superintendent of the fire alarm telegraph system. Mr. Winn was killed a few weeks ago by falling from a telegraph pole while mending a broken wire. The voting resulted in the election of Elmer W. Loomis.

Judge McPherson of the common pleas court of Dauphin county, this state, handed down an opinion a few days ago in the case of the Philadelphia Natural Gas company of Pittsburg, Pa., against the commonwealth of Pennsylvania The case involved the point whether the commonwealth had the right to a tax on the capital stock of a corporation when that capital stock is invested in patent rights. The Philadelphia company has a $1,000,000 capital for which it was asked to pay $5,000 tax per year. The company refused, and the case was taken to court, where it was decided by Judge McPherson in favor of the company. He stated that the capital stock of the corporation invested in patent rights is exempt from taxation.

E. H. H.

Cleveland, O.

CLEVELAND, Jan. 17.—The East Cleveland company has ordered a six-wheel truck from the Robinson Radial Car Truck company, Boston, Mass. If it proves satisfactory, enough will be ordered to dispense with the trailers in ordinary travel.

A motion for leave to file a petition in error to the Superior Court of Cincinnati, in the case of the City and Suburban Telegraph association against the Cincinnati Inclined Plane Railroad company was filed in the Supreme Court last Monday.

A bill will be introduced in the Ohio legislature making elective the office of commissioner of telegraph and fixing the term at three years.

Professor J. B. De Motte, Ph. D., of the De Pau university in Indiana, is to give a lecture here on "The Nature of Electricity."

Captain Mack of this city is in Washington, urging the passage of a bill which provides for the establishment of a telephone line between Sailor's encampment and the Zoo. Under the present system there is too much time lost, damage and inconvenience are occasioned in the signaling of rafts, etc

The Harrison Electric Light and Waterworks company of Harrison, O., capital stock $50,000, will be incorporated shortly.

The telegraphers on the Nickel Plate road between here and Chicago have received an advance of five dollars per month all round.

Cincinnati advertises for bids for gasoline lighting in the suburbs for five years. Suburbanites are now anxious to know if electricity is intended only for street lighting down town.

An ordinance is now before the Cincinnati B C. A. establishing a new electric railway route to the Zoo. The project is backed by Henry Martin and others.

The petition of the Woodland Electric company to erect poles encounters a good deal of opposition in the city council. There is no telling when they will obtain the long sought-for permit.

R.

Cornell University.

ITHACA, Jan. 17.—New Stanley alternate current arc lamps are now used on the campus. The number of lamps used has been greatly increased, and many desirable improvements have been made. The buildings are all lighted by Edison incandescent lamps. The dynamos are operated from a countershaft, which is so arranged as to be driven either by water power or by steam. A complete system of friction clutches has been introduced.

Frank C. Perkins, '91, is soon to publish a work entitled, "Cornell University and Her Technical Courses." The book will contain photogravures of all the university buildings with interior views of the buildings of the engineering departments, and portraits of the professors.

Thos. A. Edison has presented Dr. Thurston two No. 6 Edison generators for the university. They will be used to furnish current to run the two Sprague motors recently presented to the university.

Prof. R. C. Carpenter has placed the order for the 150-horse power experimental engine in the hands of E. P. Allis & Co., Milwaukee, Wis. The engine is to have three steam cylinders, and is so arranged that it may be run as a single, compound or triple expansion engine with or without steam jackets, and will be fitted with all known experimental appliances.

An order has been placed with Linneus Olsen & Co. for a 300,000 lb. testing machine, which will extend through three stories of the laboratory.

The department has received sample iron electric light poles to be tested for rigidity, etc.

W. N. Smith, '90, is assistant to the engineer in charge of the installation of the new Thomson-Houston road at Davenport, Ia.

L. H. Parker, '87, is engaged with the Short Electric Railway company in the construction of a road at Pottsville, Pa.

P.

THE ELECTRIC LIGHT.

The Union Electric company, Birmingham, Ala , has been incorporated with a capital stock of $50,000.

The Electric Light, Heat & Power company at Farmville, Va., has completed arrangements to erect a plant.

The Abilene, Tex., Electric Light & Power company has been incorporated with a capital stock of $20,000.

The Valdosta, Ga , Electric Light company has been formed by M. B. Lane, W. E Thomas and B. W. Bentley. The company will erect an electric light plant at once.

A committee has been appointed at Yazoo City, Md., for the purpose of investigating the question of municipal electric light plants. A movement favoring the erection of a plant by the city is on foot.

The Chicago Incandescent Light company has just been formed to manufacture and deal in electrical supplies; capital stock $15,000; incorporators, Clarence S. Olmsted, Edwin S. Osgood and Harvey R. Husted.

An English paper says that the postoffice authorities contemplate installing the electric light in the Bristol general postoffice. The sorters and other officials, who are obliged to work long hours, complain of the considerable discomfort caused by the heat of the numerous gas jets in the various departments.

The Edison Electric Illuminating company, Spokane Falls, Wash , has completed its station. Arrangements have been made to accommodate twenty-four Thomson-Houston 50 light arc machines and sixteen Edison machines with a capacity of 12,000 incandescent lights. The officers of the company are: President, F. Rockwood Moore; vice-president, John W. Chapman; secretary and general manager, W. S. Norman; electrician, John B. Fisken.

Since August 1 C. A. Ross of Kansas City, Mo., who represents the Thomson-Houston company in Missouri, Kansas and Arkansas, has sold electrical apparatus in the following places: Trenton, Mo., Richmond, Mo., Fort Scott, Kan., Beloit, Kan., Brookfield, Mo., Independence, Kan , Marysville, Kan., Lamar Mo., Kirksville, Mo., Pierce City, Mo., Seneca, Kan , Norborne, Mo., Marysville, Mo., and Kansas City, Mo. The sales included seven arc light plants of an aggregate capacity of 250 lights, ten incandescent plants of a total capacity of 5,850 lights, and three motor installations of a capacity of 13-horse power.

At a recent session of the United States District court at Dubuque, Ia., a case involving the ownership of the Iowa City Gas & Electric Light company came up for hearing, Judge Shiras reserving his decision. This case is a complicated one, and will undoubtedly be carried to the United States Supreme court. The real object is to determine the rights of the creditors of the Commercial National Bank of Dubuque to the stock of this company, it having been used by J. K. Graves as collateral, and since the failure of that concern the ownership has been almost hopelessly involved in numberless suits in different courts. A receiver is now asked for by the United States officials in charge of the assets of the bank.

A writer in an English paper calls attention to the advantages of threshing at night by electric light. He says: "Night work is particularly advantageous for the possessor of threshing machinery, which can be hired out, as the machine can thus, in a single season, earn half as much more hire. Where the farmer is limited to a certain number of laborers, and cannot procure more, it is no small convenience if they can be rendered available for other duties by a more rapid completion of the threshing. The economy of fuel is not to be despised, as the consumption is considerably less if the boiler is kept constantly hot than if it is let cool down, and steam has to be got up afresh every morning." Good results, he says, were obtained by him last season.

In the discussion on James Swinburne's paper on "Alternate Current Condensers," at the meeting of the London Physical society, A. P. Trotter said, Mr. Ferranti informed him that the capacity of his mains was about $\frac{1}{8}$ microfarad per mile, thus making $2\frac{1}{3}$ m.f.'s for the seven miles. The heaping up of the potential only took place when transformers were used, and not when the dynamos were connected direct. In the former case the increase of volts was proportional to the length of the main used, and 8,500 at Deptford gave 10,000 at London. Mr. Kapp considered the loss of power in condensers due to two causes, first, that due to the charge soaking in; and second, to imperfect elasticity of the dielectric. Speaking of the extraordinary rise of pressure on the Deptford mains, he said he had observed similar effects with other cables. In his experiments the sparking distance of a 14,000 volt transformer was increased from $\frac{13}{16}$in. to 1in. by connecting the cables to its terminals. No difference was detected between the sparking distance at the two ends of the cable, nor was any rise of pressure observed when the cables were joined direct on the dynamo In his opinion the rise was due to some kind of resonance, and would be a maximum for some particular frequency.

THE ELECTRIC MOTOR.

While owing to the holiday season and the annual stock taking period, activity at the Westinghouse shops was temporarily impaired the incoming contracts for new work have considerably accumulated. During the week ending January 14 the contracts for electric street railway equip-

ments were alone in excess of $250,000, and the company has now sufficient work under contract to keep the shops in full operation until spring. The outlook is equally promising in alternating current arc and incandescent work.

The charter of the Sterling Electric Power Storage Car company, organized for the purpose of manufacturing electric railroad motors and power storing devices, has been filed at Topeka, Kan. The capital stock is $100,000, and the first directors are: J. A. Hackett, M. S. Kimball, J. Hoopes, P. Hackett and P. P. Trueheart, all of Sterling, Rice County, Kan.

The Spokane Street Railway company has announced that as soon as the council accepts its plans it will at once commence the construction of the electric railways to supplant the present horse car lines. The material is ready for the transformation, most of it being on the ground. It will begin on Riverside avenue, and in Cannon's subdivision first, and then work to the center of the city on Sprague street. The work will not cease until the lines of the company west of Division street are converted into electric roads. The officers are: F. R. Moore, president; Herbert Bolster vice-president; J. T. Kitto, superintendent; A. S. Moore, secretary, treasurer and manager.

On December 20 the Amsterdam & Rockton Electric Railway Company opened to the public the Main and Division Street Line, just equipped, which had up to that time been operated by horses. The trial trip was a great event in the history of Amsterdam, and excited much enthusiasm among the citizens. The Market street branch, an entirely new line, was opened January 16, and its successful operation, comprising as it does some of the steepest grades ever met with in street railway practice, is considered another triumph for the electric motor. The up grade on this line is continuous for about two thousand feet, and for a short distance is as high as 12 per cent. The equipment has been in the hands of Woodbridge & Turner, electrical engineers, who have made it a model in the way of construction. With the completion of the Rockton branch the road will comprise about four miles of track, operating five cars. The track is of 48 pound Johnson girder, and 40 pound T rail. Edison-Sprague motors are used, with the new Eickemeyer winding, mounted on Brill trucks; and special track brakes are provided for use on the heavy grades. The line work is neat, strong and durable. The power plant is located temporarily in the old electric light station, but in the spring, as soon as the weather permits, a new building will be erected to accommodate both the electric light and railway plants, these two companies being now consolidated.

THE TELEPHONE.

The Chicago Telephone company is required by law to pay 3 per cent. of its gross receipts into the city treasury every six months. Last week it accordingly deposited $12,000 with the city treasury as required by the ordinance.

THE TELEGRAPH.

South American political fights have greatly interfered with the transaction of business. The government of Chili has established a censorship over the telegraph, and the transaction of business over the wires of the Central & South American Telegraph company is very much obstructed.

Unfavorable comments on the telegraph service in this country are so frequently made that it is a pleasure to note the acknowledgment of the excellent work done by a much abused public servant. The St. Louis *Globe-Democrat* makes the following editorial comment, Jan. 15: "The Western Union Telegraph company did a good piece of work in the transmission of Mr. Ingalls' speech last night. It was started at 8 P. M on seven wires running direct from Washington into the *Globe-Democrat* office. It made more than 9,000 words, and it was all in at this end at 9:55."

James A. Murphy and A. J. Lichstern, Chicago bucket shop proprietors, have at last been defeated in their fight against the board of trade and telegraph companies. The case is the one in which the bucket-shop proprietor joined to make a fight for the board of trade quotations Murphy and Lichstern asked for an injunction restraining the defendants from withholding the quotations from them, and the celebrated decision was reached that quotations and market reports are quasi public property and the defendants have no right to discriminate or refuse to give the returns to any one who asks for them. The court held that there was no law compelling the defendants to collect the quotations, and if they saw fit to discontinue that business they had a right to do so. When the day for the hearing arrived, the case was formally dismissed.

Personal Mention.

Charles D. Shain, Eastern district agent of the Edison General Electric company, was in Chicago this week.

J. R. McKee is to be general manager of the Thomson-Van Depoele Electric Mining company, with headquarters at Boston.

F. B. Badt, of the Power & Mining Department of the Thomson-Houston Electric company, Chicago, has returned from his trip to Boston and New York.

Business Mention.

The Triumph Compound Engine company of Cincinnati, state that the new year is bringing them a remarkable increase in their present business, such as to crowd their present facilities and compel them to increase their shop room largely. They are daily adding to their stock of tools and machinery in order to meet the demand.

J. H. Mason of 120 Park avenue, Brooklyn, has just issued a number of little pamphlets in which his batteries and a number of novelties are described.

Thomas J. Creaghead, consulting and constructing electrical engineer, has opened offices at 37 and 39 Mitchell Building, Cincinnati, and is prepared to do a general electrical business.

G. H. Fisher, formerly the secretary of the American Leather Link Belt company, has become manager for Chas. A. Schieren & Co., manufacturers of the celebrated patent perforated electric belting, 226 North Third street, Philadelphia, Pa.

The Leclanche Battery company of New York has removed its factory and offices to 111–117 East One Hundred and Thirty-first street, New York, where, with greatly increased space and facilities for manufacturing, the company will be able to fill orders without delay.

The Elektron Manufacturing company of Brooklyn, N. Y., has just issued a thoroughly illustrated catalogue descriptive of the Perret dynamo and electric lighting apparatus. The catalogue contains information of value to those contemplating the purchase of electrical machinery.

Among many letters in regard to Habirshaw wire, the Electrical Supply company of Chicago, lately received one from the Rockford Electrical Manufacturing company of Rockford, Ill, which says: "We have been using Habirshaw wires under the most trying conditions for the past year, and have yet to hear the first complaint. We believe it to be fully equal, if not superior to any wire on the market, and shall continue to use it in preference to any other where the highest quality of insulation is required."

Hon. W. R. Lewis, for many years judge in the Sixth Judicial District of Iowa, has retired from the bench and accepted the position as general manager of the Hawkeye Electric Manufacturing company of Davenport, Ia., succeeding Wm. Bowen, resigned. The judge will bring to the service of the company he represents, not only large experience in the business world and an extensive personal acquaintance, but will also have the advantage of having installed several electric lighting plants under his own management, and of years of study in the electrical field.

The Central Electric company of Chicago will shortly place upon the market a direct reading voltmeter and ammeter. It is claimed that these new instruments are as good as any that have been produced. They will be elegantly finished, as well as thoroughly standardized, and will be sold at a price so low that every one connected with electrical work can afford to buy one. Since the company divided up its offices and appointed heads to the different departments of the business, it has been found that one man can be profitably assigned to railroad supplies. It is proposed to vigorously push this department of the business in future. The company already controls some very valuable electric railroad specialties, which will be placed upon the market. The company will shortly present to the public a very handsome and complete catalogue of electrical supplies. The page will be 7½ inches by 11 inches, printed on heavy enameled book paper, and will be a fine sample of printing and bindery work, as well as an electrical encyclopedia. Each article will be described by a trade word, which will greatly facilitate ordering supplies, also save considerable expense when orders are sent by telegraph. The book will appear inside of thirty days.

Electrical Patents.

Issued January 13, 1891.

444,416. Electric Motor. William A. Anthony, Manchester, Conn.

Claim one reads as follows:

"An electric motor, the field magnet of which is wound with a shunt wire, the ends of which are connected with the main conductor at points on opposite sides of the motor, and is also wound with a resistance wire separate from the shunt wire and separate from the main conductor, but the ends of which are connected with the main conductor between the armature and one of the ends of the shunt wire by means of an electric switch."

444,424. Electric Light Support. Alfred Dawes, Chelsea, Mass.

444,433. Independent Electric Clock. Emil G. Hammer, Brooklyn, N. Y.

444,447. Elastic Trolley. Charles A. Lieb, New York, N. Y.

444,452. Electrical Sporting Indicator. Samuel D. Mott, Passaic, N. J.

The object of this invention is to produce a visual indicator with a plurality of changeable parts, which may be operated by an electrical circuit to indicate by the proper changes or movements of its said elements the varying conditions of any sporting event.

444,453. Electrical Sporting Indicator. Samuel D. Mott, Passaic, N. J.

444,454. Racing Indicator. Samuel D. Mott, Passaic, N. J.

444,466. Electric Lamp Bracket. Thomas C. Smith, Philadelphia, Pa.

444,471. Carbon for Arc Lights. Barton B. Ward, New York, N. Y.

444,472. Electric Arc Lamp. Barton B. Ward, New York, N. Y

The invention consists, essentially, in interposing a switch into the circuit of the derived circuit feed regulating magnet for opening and holding open the circuit of such coil, and in controlling or bringing such switch or circuit opener into operation through the action of controlling devices adapted to respond to any abnormal increase in the resistance of the circuit through the arc.

444,473. Electric Arc Lamp. Barton B. Ward, New York, N. Y.

The last claim follows:

"The combination, with the resistance frame having connected heads and a central passage or bore of a wire-supporting bar or rod provided with notches in its outer edge and with rabbets or shoulders at its inner edge to hold it against longitudinal displacement."

444,477. Conduit for Electric Wires. Alexander P. Wright, Boston, Mass.

The invention is a conduit formed of short tubes which are held end to end by means of a flexible pipe or hose, the whole forming a flexible conduit, one of whose advantages is that it is readily drawn into place behind the plastering.

444,479. Electric Car-Controlling Device. Edward M. Bentley, Brooklyn, N. Y.

The invention relates to devices for operating electric motors so that they may be readily controlled and the speed of the driven mechanism varied, the said devices being especially applicable to motors used in propelling vehicles on an electric railway, in multiple arc.

444,480. Electric Railway Car. Edward M. Bentley, New York, N. Y.

444,482. Electric Hand-Setting Mechanism for Clocks. William W. Bradley and Willard N. Packer, Canton, Ohio.

444,486. Dynamo Electric Machinery. Justus B. Entz, New York, N. Y.

The claim reads:

"In a dynamo electric machine or motor, a field magnet consisting of a single coil of wire wound upon an elliptically-shaped core, and extended pole-pieces passing from one end of the core around the side of the magnet to the other end and alternating around a circle, with pole-pieces connected to said other end."

444,512. Electric Locomotive. Montgomery Waddell and Justus B. Entz, New York, N. Y.

444,530. Leading-in Wire for Incandescent Electric Lamps Thomas A. Edison, Llewellyn Park, N. J.

444,539. Electric Railway Car. Lawrence A. McCarthy, Brooklyn, N. Y.

444,552. Electric Indicator. John Hopkinson, Holmwood, England.

444,553. Method of Controlling Currents upon Electric Circuits. John Hopkinson, Holmwood, England.

444,566. Current-Collecting Device for Electric Railways. Rudolph M Hunter, Philadelphia, Pa.

444,567. Incandescent Lamp Socket. George R. Lean, Boston, Mass.

444,587. Regulator for Dynamo Electric Machines. Royal E. Ball, New York, N. Y.

The first claim is:

"As a means for shifting the brushes to regulate a magneto-electric machine, a movable magnetic body carrying the commutator brushes and arranged in the yoke piece of the field magnets adjacent to the commutator."

444,597. Electric Magnetic Massage Kneader. David Lightenstadt and Charles Lightenstadt, Chicago, Ill.

444,599. Electric Appliance for Trusses. Alva Owen, Chicago, Ill.

444,600. Magneto-Bell. William R. Patterson, Chicago, Ill.

444,640. Electric Elevator. Norton P. Otis and Rudolph C. Smith, Yonkers, N. Y.

444,678. Lightning Arrester. Elihu Thomson, Lynn, Mass.

444,687. Conduit Inspector. Josiah L. Blackwell, New York, N Y.

444,700. Automatic Signal for Railway Crossings. Alvah W. Hall, New York, N. Y.

444,706. Electric Gas Lighter. Thomas W. Lane, Boston, Mass.

The object of the invention is to utilize in automatic electric gas burners a ratchet wheel and continuously rotating gas plug or cock, in connection with a single electric circuit for both the operations of lighting and of extinguishing the gas.

444,707. Rheostatic Switch. Joseph H. Lehman, Philadelphia, Pa.

444,735. Voltaic Insole. Mary E. Thomas, Cardington, Ohio.

444,740. Electric Railway. Edward M. Bentley, Brooklyn, N Y.

444 780. Telephone Enunciator or Indicator. George R. Lawrence, Manteno.

444,791. Phase Indicator for Alternating Electric Currents. Charles S. Bradley, Yonkers, N. Y.

This invention relates to devices for indicating the degrees of lag existing between two alternating currents, and is also applicable to the determination of the number of alternations per minute which are taking place in a single alternating circuit.

444,794. Brush for Dynamos. Almerin S Cook, Cambridge, Mass.

444,803. Potential Indicator. Edward Weston, Newark, N. J.

444,804. Electrical Measuring Instrument. Edward Weston, Newark, N J.

444,805. Electric Measuring Instrument. Edward Weston, Newark, N. J.

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The Electrical Commissioners of the District of Columbia invite communications from firms interested in electric cables, conduits, subways, etc. Also, upon the subject of municipal electric lighting, electric transmission of power, etc. Communications received until March 1, 1891. Personal interviews cannot be granted at present. Address, Electrical Commission, Room 30, District Bldg., Washington, D. C.

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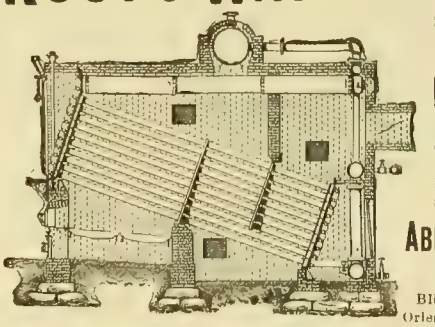

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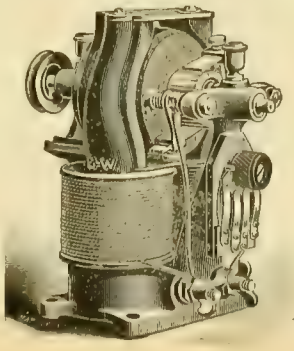

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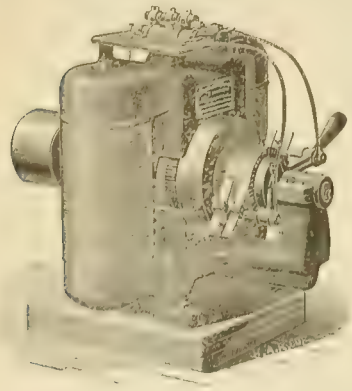

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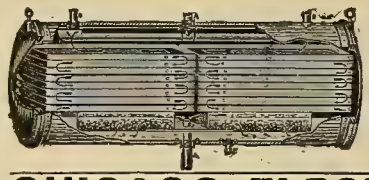

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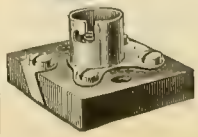
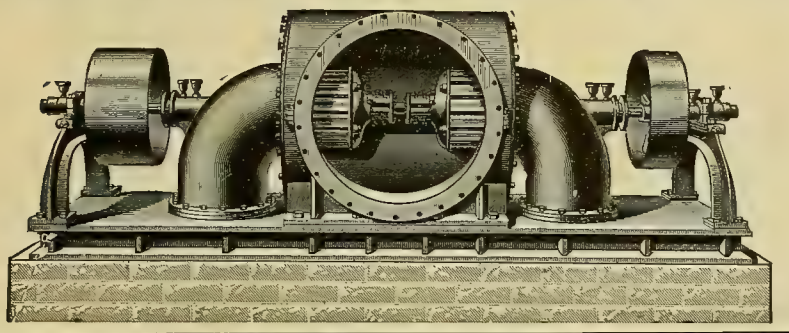


EDISON LAMP COMPANY, Harrison, N. J.

VICTOR TURBINE WATER WHEEL



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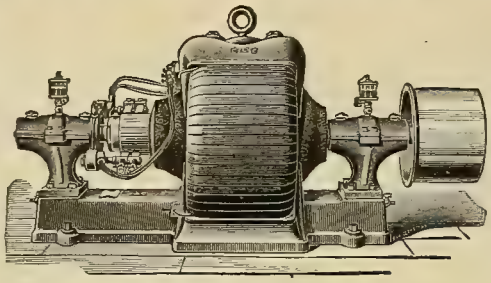

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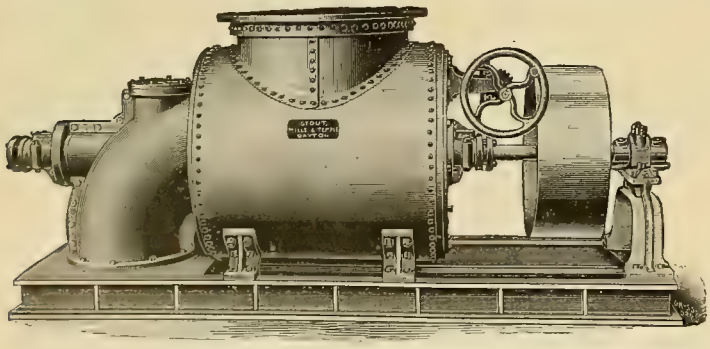

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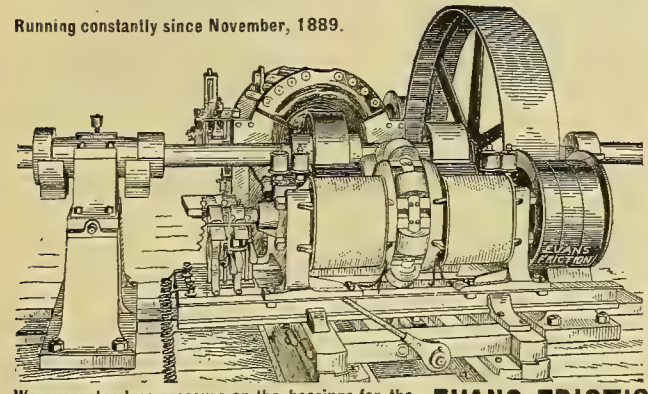

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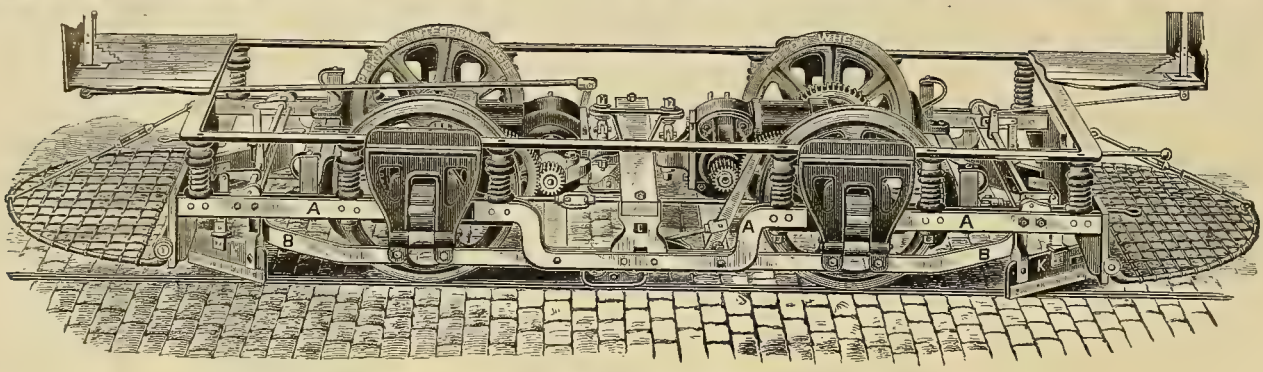

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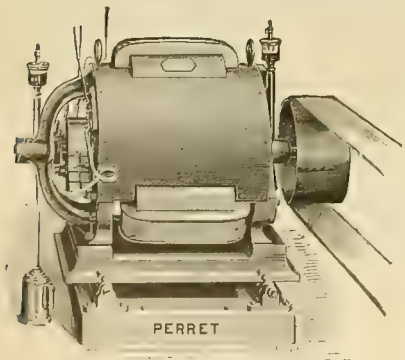

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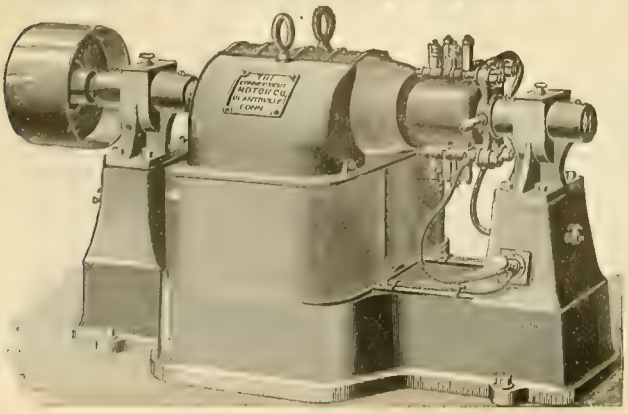

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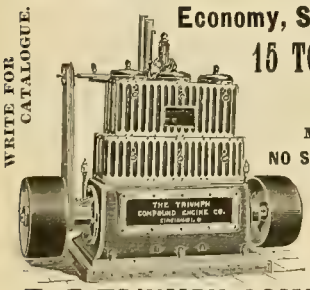

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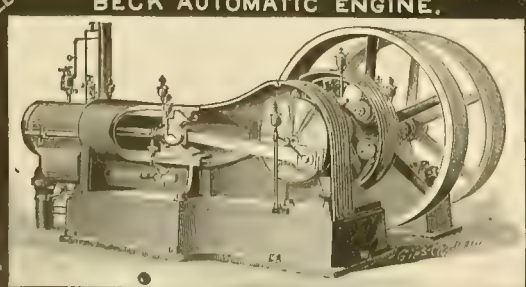

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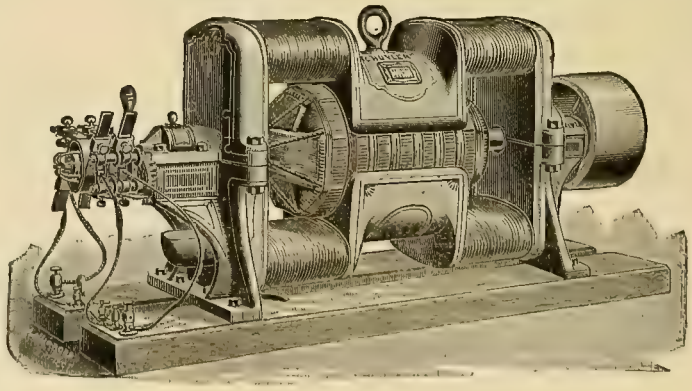

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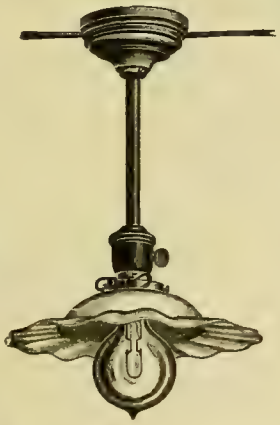

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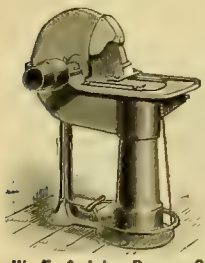

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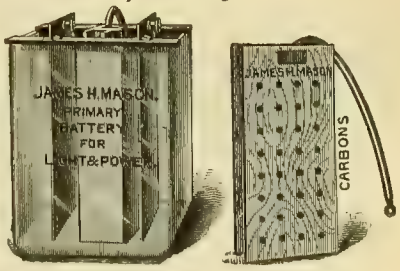

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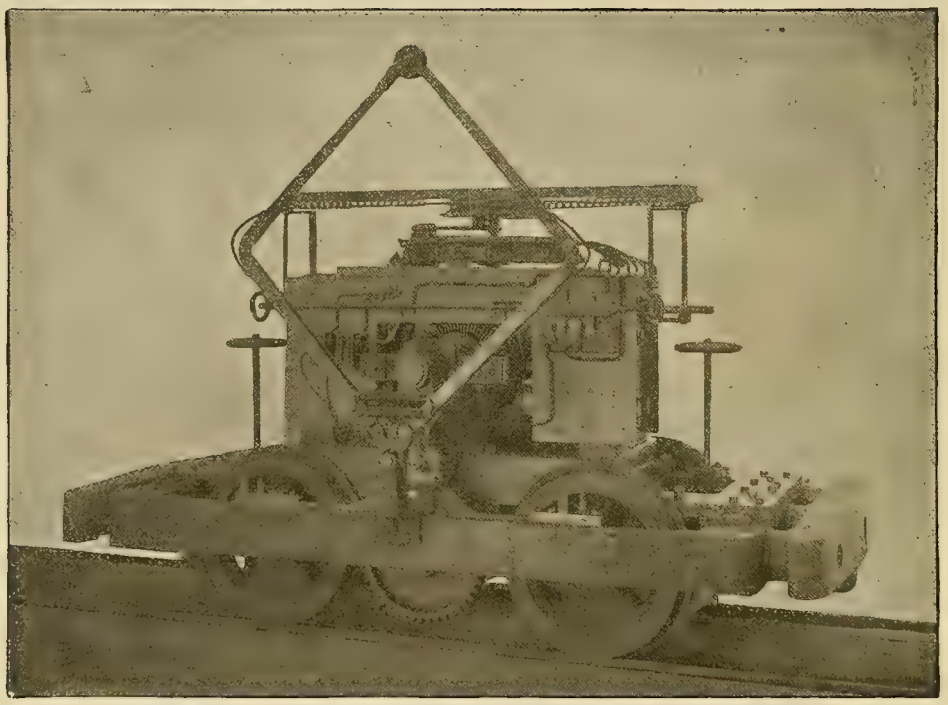

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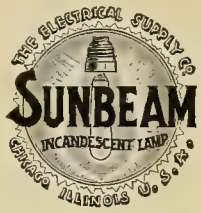

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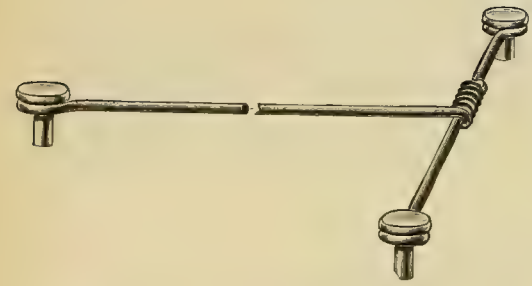

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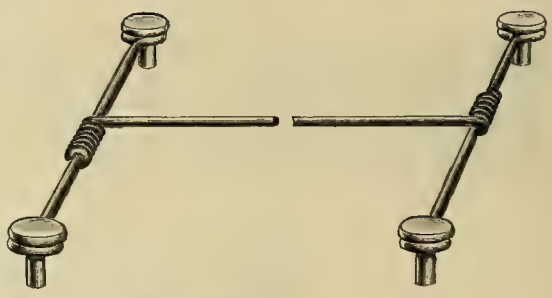

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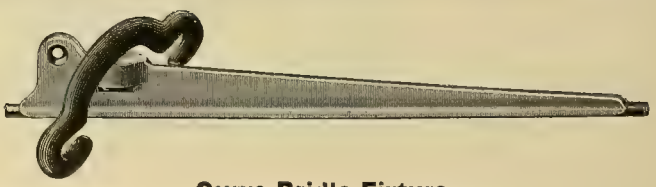

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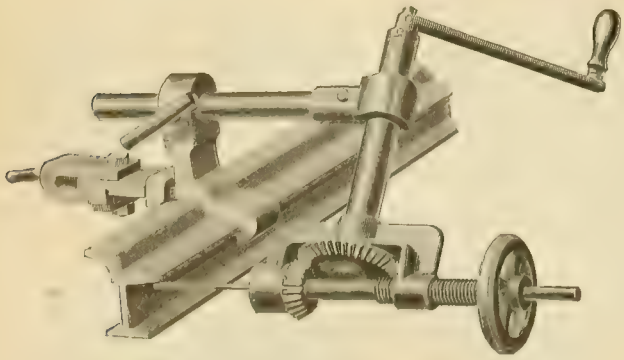

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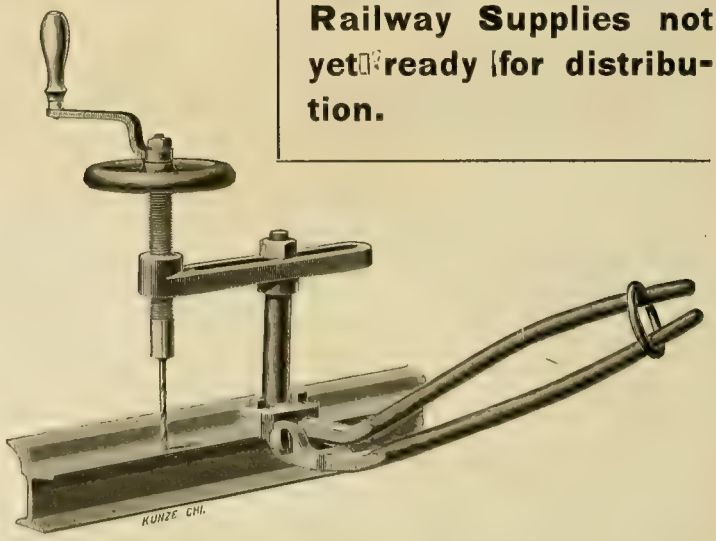

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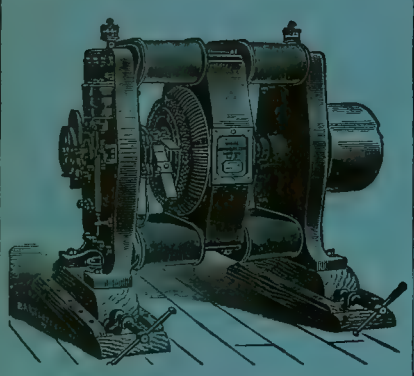

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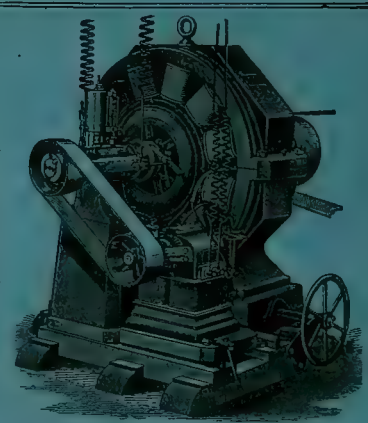

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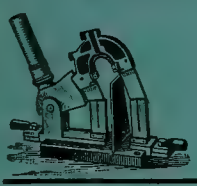

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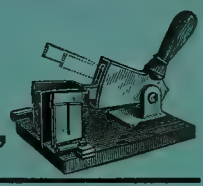

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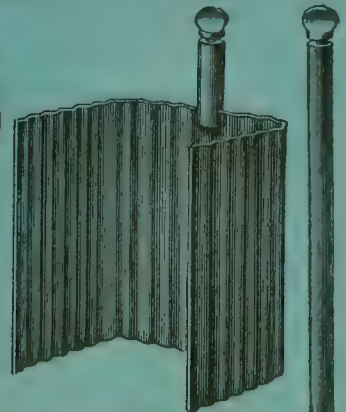

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The figures referring to "total of all systems," taken from table published in August number of "Electrical Industries," are of undisputed accuracy.	Total of all systems.	Thomson-Houston System.	
		Number.	Percentage to total of all Systems.
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Vermont, - - - -	12	11	91⅔ per cent.
Tennessee, - - - -	16	16	100 per cent.

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Great Western Electric Supply Co.
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International Okonite Co., The.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Roebling's, Jno. A. Sons Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

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Great Western Electric Supply Co.
Illinois Electric Material Co.
Monitor Electric Co.
N. W. Thomson-Houston Elec. Co.
Southern Electrical Supply Co.
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Automatic Switch Co.
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Empire City Electric Co.
Fletcher & Fletcher Electric Co.
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Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
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Partrick & Carter Co.
Paiste, H. T.
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St. Louis Electrical Supply Co.
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Van Nuis, C. S.
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Dynamos.
Brush Electric Co.
Bain, Foree.
Card Electric Motor & Dynamo Co.
Colburn & Co., I. W.
Continental Dynamo Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Shawhan Machine Works.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co. The.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Partrick & Carter Co.
Queen & Co.
Star Electrix Co.
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Weston Electrical Instrument Co.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.
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Electrical Supply Co., The.
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Evans Friction Cone Co.

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Cleverly Electrical Works.
Electrical Supply Co., The
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.
Wollensak, J. F.

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American Electrical Works.
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Brush Electric Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Cleverly Electrical Works.
Edison General Electric Co.
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Electrical Supply Co., The.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
International Okonite Co., The.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
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Partrick & Carter. Co.
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Partrick & Carter Co.
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St. Louis Electrical Supply Co.
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Central Electric Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co. The.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulation Co.
International Okonite Co , The.
India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
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Eureka Tempered Copper Co.
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Buckeye Electric Co.
Central Electric Co.
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Edison Lamp Co.
Edison General Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co. E. S
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Sawyer-Man Electric Co.

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St. Louis Electrical Supply Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
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Munsell & Co. Eugene.

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Thomson-Houston Electric Co.
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Brush Electric Co.
Baxter Electric Motor Co.
Card Electric Motor & Dynamo Co.
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Knapp Electrical Works.
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Queen & Co.

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Gibson Co., The W. D.

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Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
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Illinois Electric Material Co.
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Greeley & Co., E. S.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Standard Electrical Works.
Western Electric Co.

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Standard Electrical Works.
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Electrical Supply Co.
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Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

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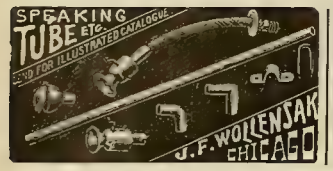

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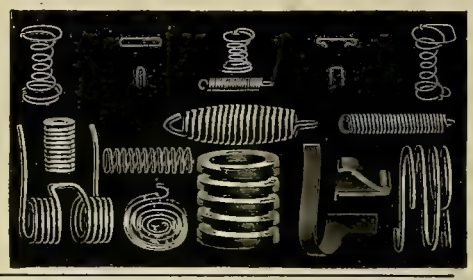

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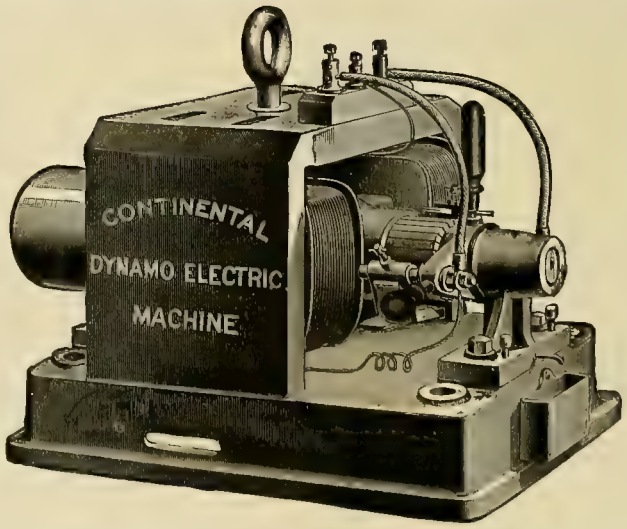

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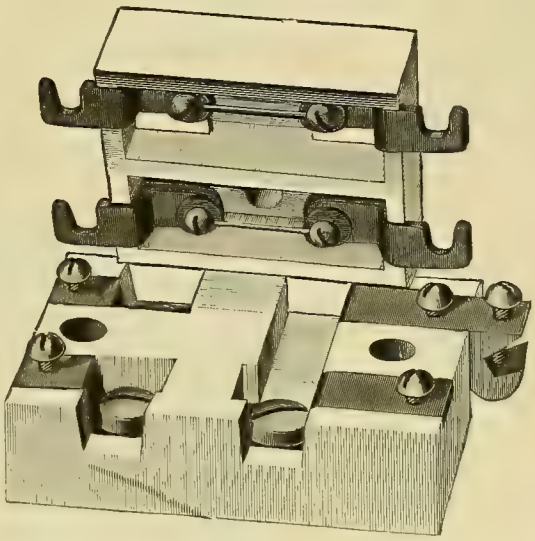
We are General Selling Agents for Holmes-Booth & Hayden's Patent Weatherproof Electric Light, Line and House Wires, which have no superior.



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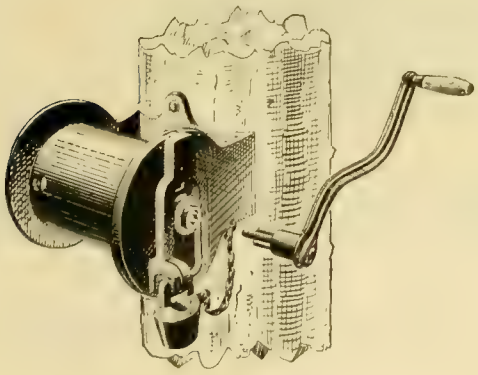
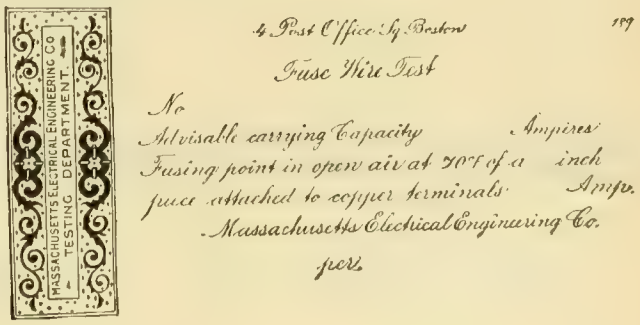


We have a large stock of the Windlasses shown by the cut, which are the best and most reliable on the market.



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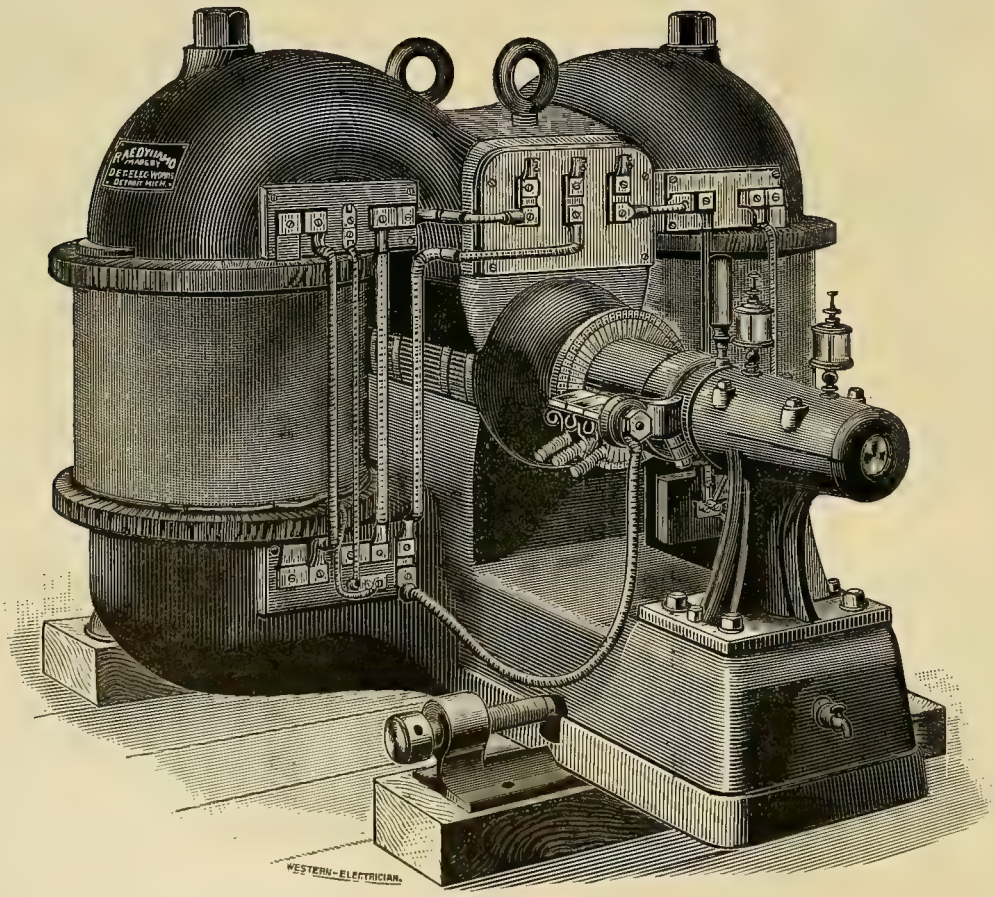

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CONVERTER EFFICIENCIES.

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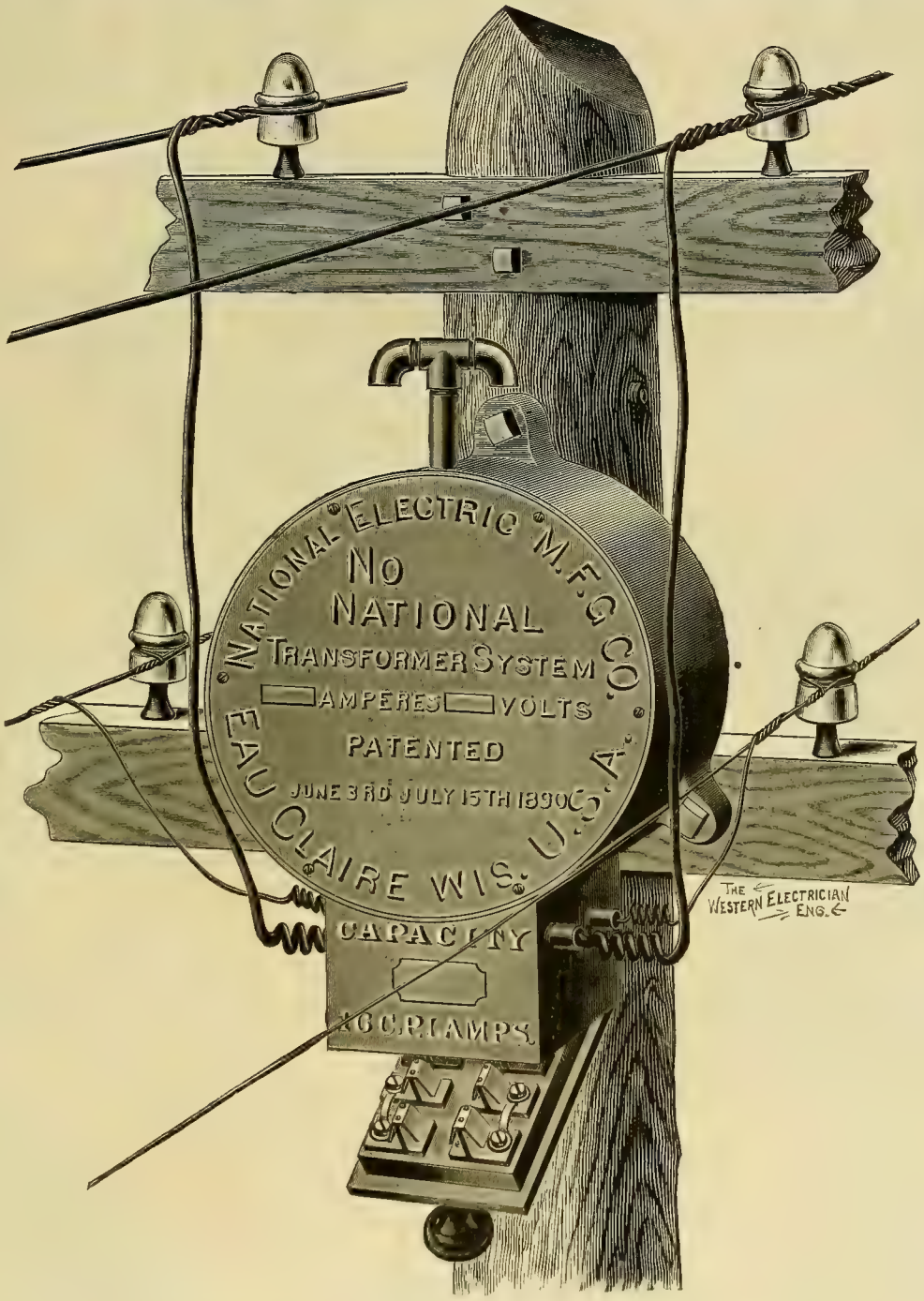

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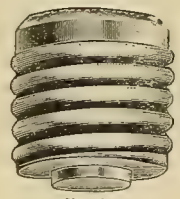

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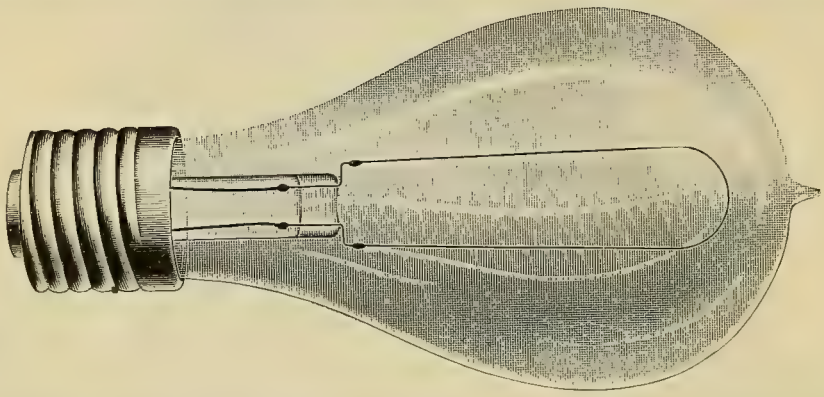

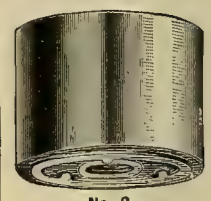

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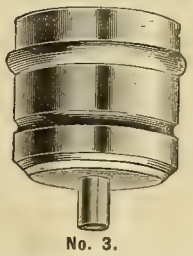

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OKONITE WIRE.

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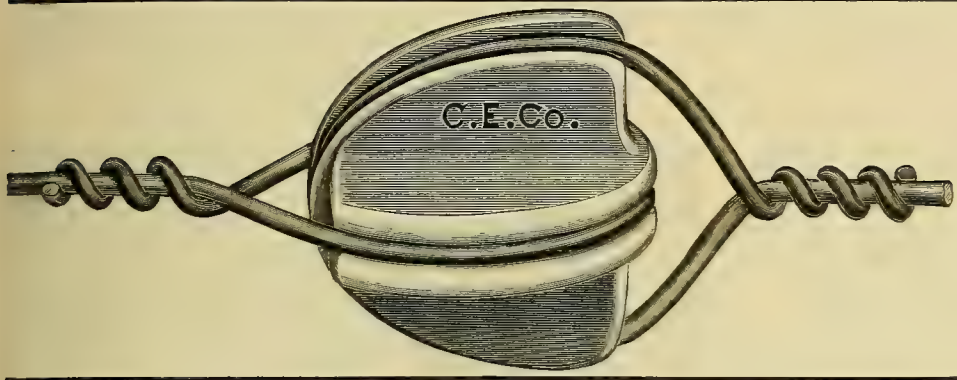

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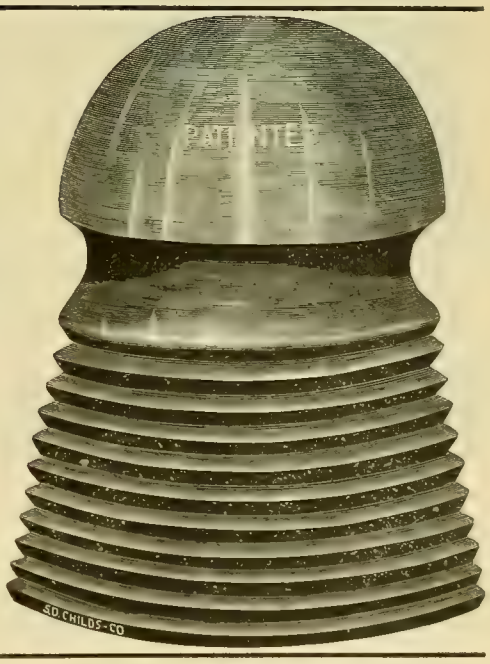
For Suspending Arc Lamps, Insulating Guy Wires, Insulating Span Wires in Electric Railroad Work, is so simple and perfect in construction as to need no explanation.

THIS NEW
HIGH RESISTANCE GLASS
INSULATOR



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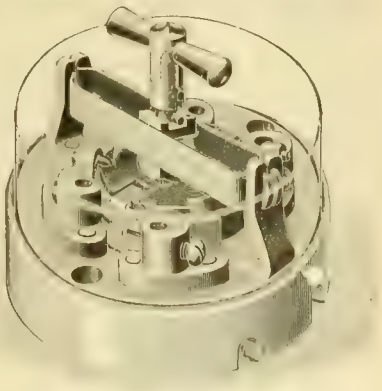

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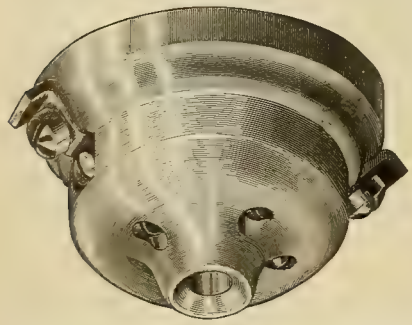

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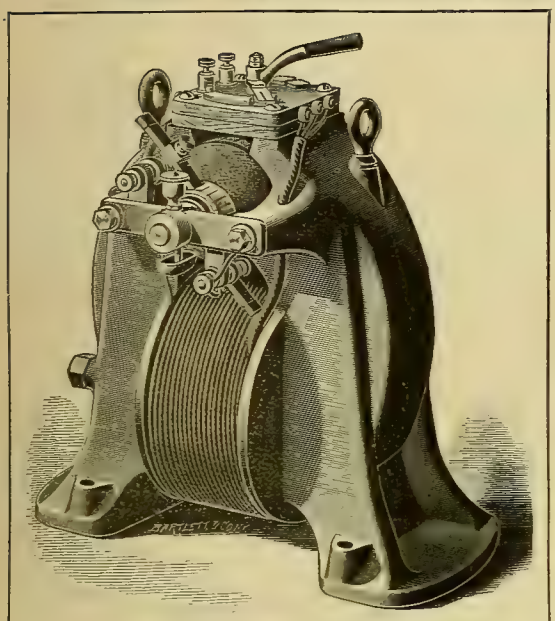

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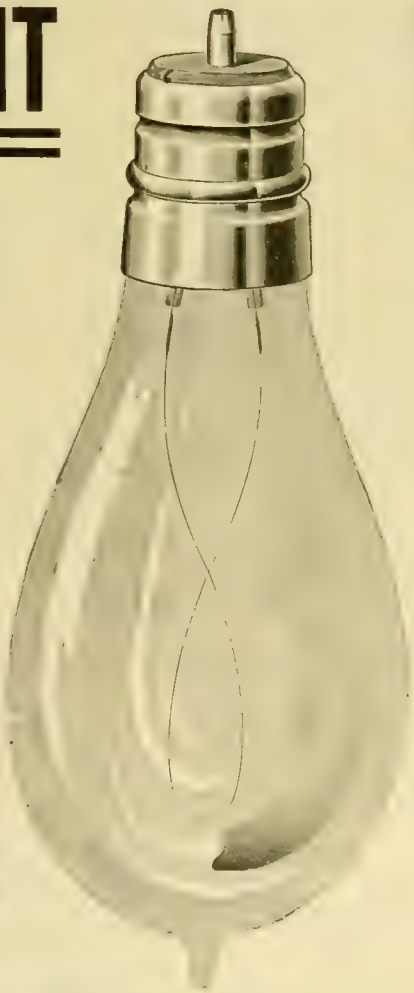

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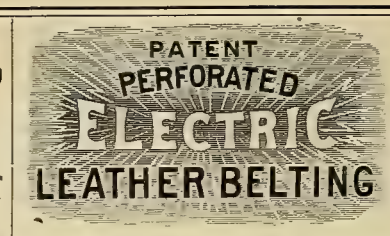

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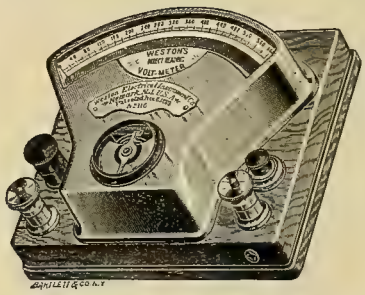

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Vol. VIII. CHICAGO, JANUARY 31, 1891. No. 5

Electrical Stage Fixtures at the Chicago Opera House.

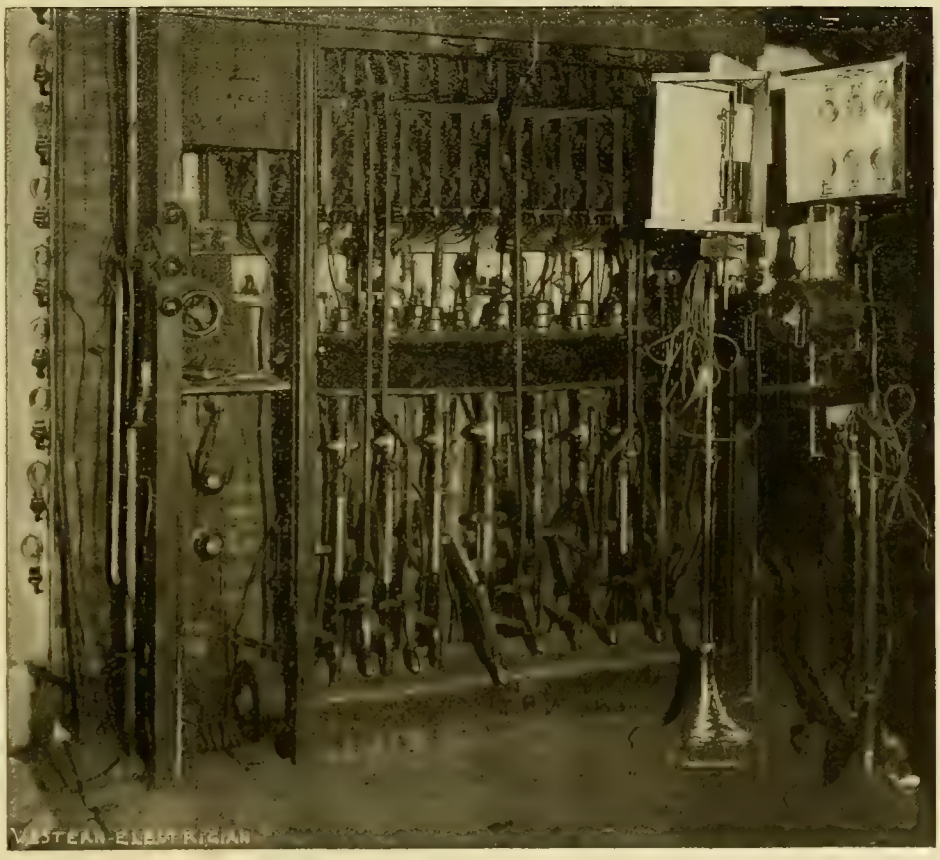
Ever since electricity came to the front as an illuminant for the majority of the best theaters in this country, it has been the ambition of the theatrical electrician to dispense entirely with gas and the calcium light in the production of fine stage effects. The use of gas jets behind the scenes after the incandescent lamp was introduced, soon became a thing of the past, but the calcium light has had a longer lease of life, and in most of the theaters still retains its place. The calcium light, however, is far from perfect in fulfilling its mission. It not only keeps up a continual hissing, but it is more or less dangerous, and its use by any one except an expert may lead to an explosion. In addition it is expensive and hard to handle. With these disadvantages in view it is not surprising that electricity is welcomed as a substitute.

Among the theaters in which the calcium light has had to take a second place is the Chicago Opera House. Through the courtesy of Martin F. Kruger, electrician in charge, the WESTERN ELECTRICIAN is enabled to give a description of the several types of electric lighting apparatus now employed in this theater. The cut in the main represents the stage switch-board, and to the right in the picture are shown the lamps.

The general construction of a "bunch light" carrying in front of its white reflector six 16-candle power incandescent lamps, will be seen at a glance. The tall side light-stand at the left of the bunch light, carries the arc lamp which takes the place of a calcium light for stage work. The shortest lamp-stand of the three carries a focusing lamp, the lens attachment of which enables the operator to enlarge or diminish the area of focused light, from a small spot to a circle several feet in diameter. The total weight of this apparatus is fifty pounds. Each of the three lamps is so hinged to its stand that the rays may be turned in any desired direction. All the lamps shown except, of course, the bunch light, are arc lamps and are operated from a 110-volt incandescent circuit. These arc lamps work at about 50 volts and 16 amperes, consequently it is necessary to employ an extra resistance with each one. These lamps are manufactured by the Scott Electrical Works, New York, and are handled in the West by Mr. Kruger.

In addition to the three lamps represented in illustration, Mr. Kruger has recently applied a parabolic reflector to an arc lamp so as to dispense with the gallery calcium lights. To produce the mellow light which is characteristic of the calcium light, sheet gelatine, colored a pale amber, is interposed between the arc and the stage. Where it is necessary to change the color of the light, tinted sheets of gelatine mounted in frames are employed.

It is stated that a the current to operate a single arc lamp with its resistance, when supplied from the circuit of the local electric light company, costs a little over 20 cents per hour. Bearing in mind that the current is metered and that the lamps are only used at intervals, a comparison of the above figure with $1.67 per performance for one calcium light, makes a favorable showing for electricity.



ELECTRICAL STAGE FIXTURES AT THE CHICAGO OPERA HOUSE.

The switch-board shown is most complete in its arrangement. The row of levers at the bottom control the border lights by cutting in or out resistance by means of the contacts at the top. The valves just above the row of levers last referred to, control the gas in all parts of the house. The row of levers extending outward at the top of the board control the lights in the proscenium, the colored and white footlights, the house lights and the bunch lights.

Chicago Druggists and the Telephone.

Retail druggists of Chicago who induced Senator Thiele to introduce a bill in the Illinois legislature providing for a reduction of telephone rates, met at the Sherman House last week and organized for the purpose of lending "substantial aid" to the project. C. L. Feldecamp was chosen president and Victor Dunbeck secretary. The method of procedure was not made public.

Belding Motor Company's Factory Destroyed by Fire.

The factory of the Belding Motor company at Hermosa, a suburb of Chicago, was destroyed by fire last week. The building had been completed only a short time, and at the time of the conflagration was being fitted up with new machinery. The patterns, dies, machinery, etc., used in the old factory had not yet been removed and the company will therefore be able to continue its work until the damage caused by the fire can be repaired.

The fire originated in an annex to the Belding company's factory, occupied by the Expanded Metal company. The two factories were entirely distinct, and as an officer of the Belding company expressed it, had there been half a dozen barrels of water available at the time the fire started, all would have been saved, but there was no pressure whatever on the city mains and the firemen could do nothing but watch the building burn. Part of the machinery which had been placed on the second floor of the building fell during the fire and was considerably damaged. The boilers, engines and pumps were not damaged. The company estimates the damage to the building at $30,000, which is fully covered by insurance. The damage to the machinery, however, about $5,000 or $6,000, will be a complete loss. The greatest loss the company will experience is the delay caused by the fire. It will be six weeks or two months before the building will be ready for occupancy. Until that time, however, the company will continue in the old factory.

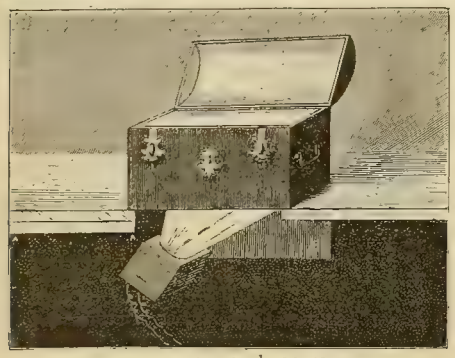
Regulating Telephone Charges.

Representative McInerney of Chicago has introduced a bill at Springfield providing that the rental for telephones in towns having a population of 75,000 or more shall not exceed $5 per month. The bill also provides that in cities and villages having less than 75,000 the rate shall not exceed $4 per month. The fight for cheaper telephone service is growing more interesting each day. The Chicago city officials who have been interviewed on the subject favor McInerney's bill, but there is little hope expressed for its passage. It is generally recog-

nized that the amount named is not a fair rental value for a telephone, and it is hardly possible that such an unjust measure will be enacted.

Making a Fairy's Dress.

In one of the spectacular plays now on the boards in Paris, a fairy story is told. In the course of the play the fairy's wardrobe is exhibited in several trunks. It is necessary of course that the fairy's raiment shall be unnaturally brilliant, and to accomplish the proper effect recourse is had to the electric light, as shown in the cut. The little trunk containing



MAKING A FAIRY'S DRESS.

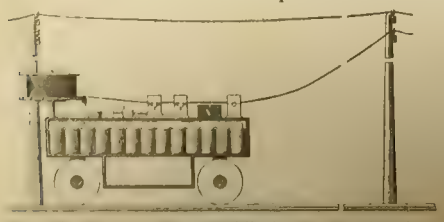
the dresses is brought upon the stage, and placed over a trap door. The trunk is so made that when it is placed on the stage the bottom *B* falls out. At that instant rays of light from the lamp *C* underneath the stage are directed upon the gauzy dress in the trunk, causing it to assume the proper luminous effect deemed desirable in a fairy's costume.

Welding Telegraph Wires with the Storage Battery.

Ever since the practicability of welding by electricity was demonstrated, inventors have been at work devising methods of applying the new process to save the labor and other inconveniences attendant upon welding by the aid of the forge and hammer.

The accompanying illustration represents diagrammatically one of the proposed applications of the electric welding process. The welder shown was designed by Elias E. Ries, of Baltimore, Md., for the purpose of joining the ends of telegraph wires.

The apparatus is mounted, as shown, so that it may be readily transported from place to place. When used upon the ordinary telegraph line alongside the railway, the box will be mounted on wheels adapted to travel on the track, but otherwise the wheels will be such as are used on wagons. Near one end of the box is erected a spindle carrying a reel containing the supply of wire. On the box there is a pair of welding jaws. One of these jaws is movable in relation to the other, and is insulated from it. These clamps are respectively connected to the terminals of a storage battery located within the box. The elements of the battery are so coupled as to supply a current of sufficiently large volume for the work to be performed. In one of the conductors is interposed a rheostat.



WELDING TELEGRAPH WIRES WITH THE STORAGE BATTERY.

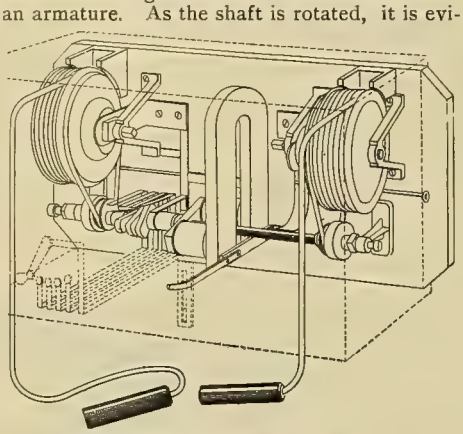
Near the end of the box opposite that on which is mounted the reel there is a gripping device.

When it is desired to join the ends of two wires to form a continuous line structure, the end of one of the wires is placed in one of the clamps. The wire is also placed in the gripper so that the strain caused by the weight of the wire between the welding device and the pole to which it is secured is borne by the gripper instead of by the welding clamps. The end of the wire carried by the reel is next fixed to the movable clamp. The current from the battery is now allowed to flow and the weld is soon completed.

Electrical Exercising Machine.

The cut illustrates an improved electrical exercising machine designed by J. B. Gardner of Nyack, N. Y. In this machine there are employed two separate and distinct sets of pulleys, springs, etc., and series of connecting devices, by means of which the magneto electric mechanism is operated by each of the "resisting-pulls." By this arrangement there is obtained not only a complete independence in the operation of the electric apparatus by the resisting-pulls, but heavy and noisy ratchet devices, it is claimed, are dispensed with.

The construction of the machine will be readily understood from the cut. The main shaft of the magneto-electric mechanism carries an armature. As the shaft is rotated, it is evi-

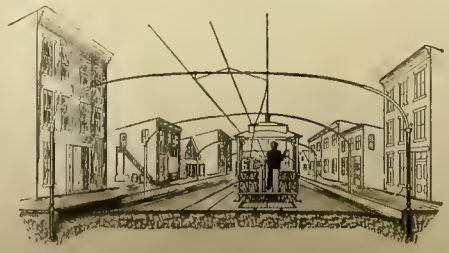


ELECTRICAL EXERCISING MACHINE.

dent that the movement of the armature within the field of force of the permanent magnet, will generate a current of electricity. On the shaft are carried ratchet devices by which the shaft is actuated when moved in one direction and allowed to remain at rest when moved in the opposite direction. The ratchet devices are moved by belts which in turn are operated by the larger pulleys. To the last named pulleys are fastened the operating handles. It is evident that when either of the pulls is operated a complete independence of the generating mechanism is secured, and a current may be obtained, whichever handle be operated. In order to afford the necessary resistance to the muscular effort of the operator and provide means to return the pulley to its normal positions, an adjustable spring is provided.

Overhead Electric Railway Construction.

In building electric railways in which an overhead trolley wire is employed, it is customary to set the poles at a considerable angle to the vertical, opposite poles inclining in opposite



OVERHEAD ELECTRIC RAILWAY CONSTRUCTION.

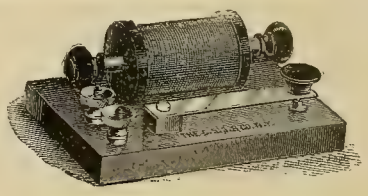
directions, and to draw them inward by means of the connecting cross-wires. The purpose of this construction is to furnish a degree of tension upon the cross-wires sufficient to prevent sagging when the trolley wires are attached. It becomes necessary in this arrangement to use poles of considerable size and strength in order to withstand the strain. The tension of the cross-wire causes also an unsightly curvature of the poles.

With the view of overcoming these objections, J. S. Hughes, of St. Paul, Minn., designed the supporting framework illustrated in the cut. A glance is all that is required to make clear the construction.

Upright posts are erected at each side of the street, and between them is sprung an arch spanning the street, as shown. The arch is tubular and of semi-elliptical form. The arch is constructed in three or more sections, the extremities being of larger diameter than the middle portion. For instance, the posts may be three inches in diameter, the extremities of the arch two inches, and the middle part about one and one-half or one and three-quarters inches. It will be observed that the pressure on the posts is in a vertical direction, and that there is no side strain whatever, thus enabling posts of small section to be used.

Frey Magneto-Electric Brake.

The accompanying cut represents the Frey magneto-electric brake. This is a convenient little contrivance for checking the swing of the needle or system or a fiber suspension galvano-



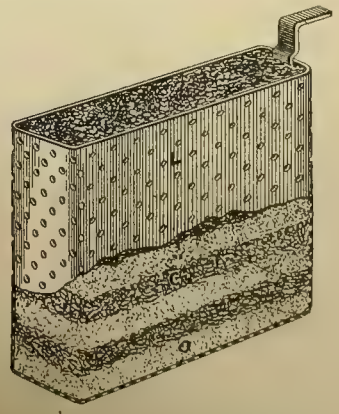
FREY ELECTRO-MAGNETO BRAKE.

meter, by sending a slight induced current through the coils, the effect of which is to tend to swing the system in a direction opposite to that in which it is moving. The current being slight and capable of being nicely regulated, the deflection can be readily brought to zero. This instrument consists of a coil, the terminals of which are connected with the galvanometer through a contact key. A small bar magnet is pushed or pulled through the coil. This device is being placed on the market by the E. S. Greeley & Company of New York.

Bain's Storage Battery Electrode.

The electrode shown in the cut was designed to present to the action of the electrolyte a comparatively great extent of surface of active material; to reduce the bulk and weight of the battery to the minimum consistent with durability; and to avoid the objectionable qualities of the grid.

To manufacture the element, which is the invention of Foree Bain, Chicago, a perforated pocket *L* of type metal is first formed. Into the case is introduced a dry powdered oxide of lead, so as to form at the bottom a stratum *O*, say, one-half inch thick. On top of this powder is placed a layer *C* of granulated coke or other carbon. These strata alternate with each other in the pocket, and fill the latter. Incorporated with the active material is, say, about 2 per cent. of bisulphate of mercury. The purpose of the mercury is to effect an amalgamation of the lead pocket, and produce a better contact between the porous strata and the lead walls of the pocket. The purpose of the porous material,



BAIN'S STORAGE BATTERY ELECTRODE.

is to allow free access of the electrolyte to a large extent of active material, and to act as a good conductor between the active material and the walls of the pocket. This construction is claimed to make the battery of a very low internal resistance and render available practically all of the active material contained in the envelope *L*. If the intimate contact be maintained between the active material and the type metal case, there will be, it is stated, no excessive sulphating, and the internal resistance is not increased with the charging of the battery, or while the latter is being worked nearly up to its maximum load.

Preservation of Bodies by Electro-plating.

It is generally conceded that up to the present time, at least, modern skill has never equaled the proficiency of the ancient Egyptians in

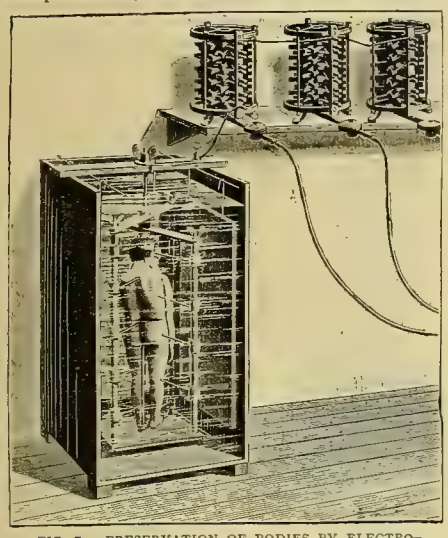


FIG. 1. PRESERVATION OF BODIES BY ELECTRO-PLATING.

producing means for preserving dead bodies from disintegration. Within the last few months however, Dr. Variot, one of the most distinguished physicians in the hospitals of Paris, has invented a process to accomplish this result, which he deems far more effective than the Egyptian methods. He simply electro-plates the body with a film of metal. The metallic envelope may be bronze, copper, nickel, silver or gold as may be considered desirable.

The means which Dr. Variot has adopted are shown in the accompanying illustrations. The cuts are made from views taken in the laboratory in which Dr. Variot conducts his experiments. The cuts show the body of an infant supported in a frame-work with four uprights joined at the top and bottom to two square plates. In Fig. 1 the body is shown in a sulphate of copper plating bath; in Fig. 2 it is arranged under a bell-glass. The body is pierced by a metal rod, one end of which terminates at the arch of the skull and the other is sunk in a metal socket at the lower plate. The frame-work is a conductor. The uprights and wires are carefully insulated up to the points of contact.

The current is furnished by a battery of three Chaudron thermo-electric cells. A serrated metallic contact extends from the upper plate and rests lightly upon the crown of the head. The feet and palms of the hands rest on contacts. Adjustable contacts in addition are arranged on the metallic uprights, and are applied to different parts of the body.

To make the skin a good conductor nitrate of silver is applied by means of an atomizer. The skin becomes a dead black. It is then necessary to reduce the silver salt or separate it from its oxide. This is accomplished with no little difficulty. The frame-work is placed in the bell glass which is exhausted by an air pump. Vapors of phosphorus dissolved in bisulphide of carbon are then allowed to enter the receptacle. It is a dangerous ope ation, inasmuch as the phosphorus is liable to ignite. This operation is shown in Fig. 2. The operator at the right controls the apparatus for admitting the vapor into the bell glass. The solution containing the phosphorus is gently heated by a gas jet until it readily gives off fumes.

As a result of the chemical reaction the coating of nitrate of silver has been turned to a grayish color. The body presents the appearance of a plaster cast. Nothing remains except to place the body in the electrolytic fluid as shown in Fig. 1. A uniform film of metal is deposited over the entire surface of the body. The progress of the electro-plating is carefully watched so that the film on the face will not be so thick that the features will appear distorted. On the face the film, it is stated, should not be thicker than one-half or three-quarters of a millimeter. On the neck, trunk, arms and legs where the preservation of the exact form is not considered so essential, the metal may be deposited to a thickness of one millimeter or one and one-half millimeters. The metallic envelope thus formed is sufficiently strong, it is said, to prevent the bending of the body and to preserve it from injury when moved.

L'Illustration from which the cuts are reproduced, says in all probability that the metalizing of bodies will never become a common practice, but that the rule "Dust thou art, unto dust thou shall return," will prevail. The process however will serve the useful purpose for which it was originally designed, that is the preservation of anatomical specimens for the use of physicians.

Electric Railway Construction.

W. J. Hield, who has had charge of the railway construction in Minneapolis, has been engaged in inspecting electric railways in different parts of the country for several weeks. His object has been to ascertain what improvements have been made in general construction. When in Chicago last week Mr. Hield was asked by a representative of the WESTERN ELECTRICIAN in reference to the results of his trip. He said:

"To tell the truth, I have not found a great deal of work that is better than we have in Minneapolis. Most of the work is side pole construction, while we have center poles in Minneapolis. I like the center poles better. They make a more sightly, and more substantial construction. The location of poles in the center of streets has been objected to on account of danger, but we have not found the objection a valid one. The tendency now is in the direction of better construction. In a good many places the work was done as if it was to be merely temporary. It has been realized that this was a mistake, as the cost for repairs was so great.

"There is a tendency to use larger cars, and dispense with trailers. Such a change is advantageous in my opinion. In Boston they will use cars which will hold one hundred persons, and two 30 horse power motors will be employed instead of two 15-horse power motors. In the summer time when open cars are run the motors on the box cars will not be housed, but will be transferred to the open cars. This is a wise course, for motors lying idle in car barns depreciate more than if they were in service.

"Electric railways are operating satisfactorily. Those interested say they have overcome the troubles which bothered them at first. These troubles were serious enough, too.

"In Minneapolis 65 or 70 miles of electric railway have been built, and there is as much more to construct next year. Another road must be built to St. Paul to accommodate the enormous traffic. I have found from what has been told me that we are operating our cars in Minneapolis on less power per car than any road in the country. The reason is, I assume, because we have used so much copper. No road has nearly as much. They are finding, however, that it is advisable to use more copper, and some of them are remodeling their lines with that end in view."

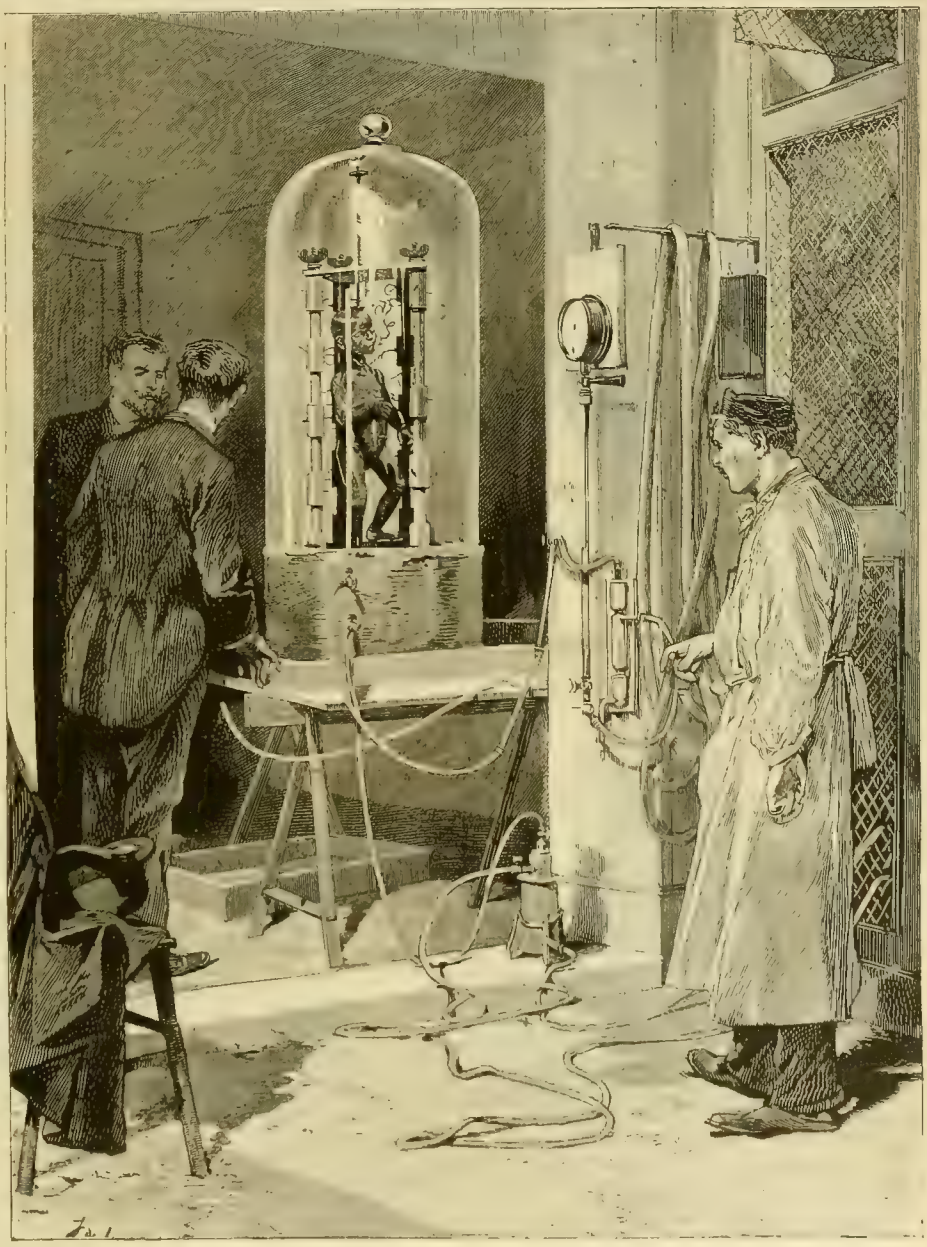


FIG. 2. PRESERVATION OF BODIES BY ELECTRO-PLATING.

Bain's Small Motor.

In the early days of dynamo and motor construction small machines did not receive the attention in building that was given to the larger sizes, and as a consequence, a great number of very inefficient small motors have been put on the market. That it is no easy task to design a highly efficient small motor or dynamo is well known, but it is only recently that electrical engineers have begun to realize that there is work for them in this field.

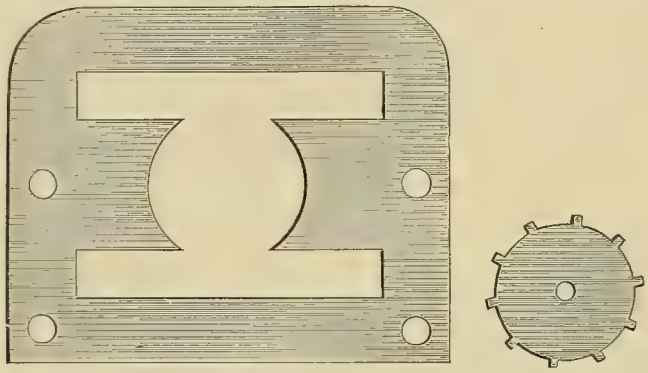


FIG. 1. BAIN'S SMALL MOTOR.

Among those who are making a specialty of small machines is Foree Bain, Chicago. One of Mr. Bain's latest productions is the motor illustrated herewith. In this little machine the field magnet and armature core are made up of pieces, Fig. 1, stamped out of the best soft sheet iron. These pieces, which form a laminated field magnet, before being put together, are varnished. To keep the pieces in close contact so as to form one solid mass, two bars, one on each side, are passed through all the pieces and pinned at both ends, Figs. 2 and 3. The two bars just mentioned also hold in place the two end castings, each of which carries one armature bearing. As will be seen, this construction makes the motor iron-clad.

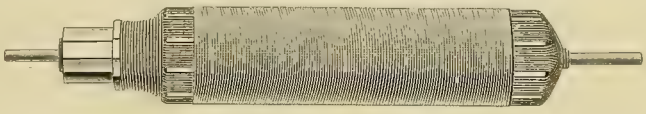
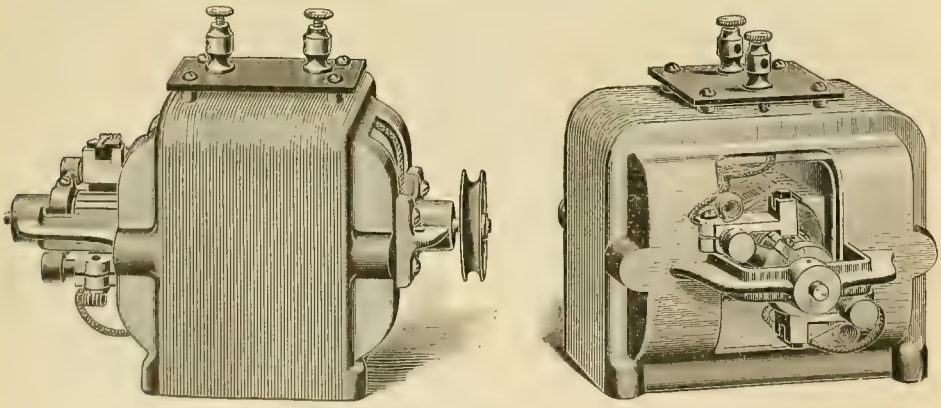


FIG. 4. BAIN'S SMALL MOTOR.

The armature, Fig. 4, has a Siemens core with Paccinoti projections and its winding is a modification of that of Froelich. The commutator is large and solidly made. The brushes are of a peculiar material, resembling carbon.



FIGS. 2 AND 3. BAIN'S SMALL MOTOR.

The advantages claimed for this little motor are as follows: The field magnets are laminated and there are no joints in the magnetic circuit. The field coils are placed as near to the armature as possible, all the lines of force of the field coils are concentrated in the cores and there are no radiating magnetic lines of force, as the machine is iron-clad. The machine is self-contained and practically speaking has no nuts, bolts or screws to become loosened.

Machines of this type are built in sizes from one-twelfth horse power to one horse power. They are wound for battery work from two volts to twenty-five volts, for 110 volt circuits and also for constant current circuits for six and one half and ten amperes.

Electric Lights for Decorative Purposes.

The annual meeting of the Sons of Pennsylvania was held at the Palmer House, Chicago, last week. The banquet hall was handsomely decorated for the occasion, and a profusion of incandescent lamps added to the splendor of the occasion. Over 400 incandescent lights were arranged about the banquet hall, and an extra dynamo of the Western Electric company's make was installed in the basement for the occasion. The wiring and arrangement of the lamps was done by the Western Electric company, Chicago.

Electric Street Railways for Chicago.

There is a good deal of talk just now in Chicago about electric street railways, both for the city and its suburbs. The Calumet Electric Railway company will ask the city council for necessary franchises to extend its line from Burnside west on Ninety-fifth street to Michigan avenue, and south on Michigan avenue to Pullman. Connections between the present electric line and the Cottage Grove avenue cable line, will also be made.

The entire right of way has been secured on Ninety-fifth street from State street to Western avenue. The necessary village ordinances have also been obtained. Last week a meeting was held, and property owners were asked to contribute $50,000 toward building a road-bed from State street west to Crawford avenue. This demand was taken into consideration, and a committee composed of B. F. Jacobs, C. T. Gilbert, L. A. Roy, W. E. Johnson and F. A. Barnes was appointed to secure guarantees for the sum required. This line as now projected will reach to Evergreen Park, but property owners at Oak Lawn are urging its extension to that point. A line north from Ninety-fifth street on Loomis street is also contemplated.

The Chicago, Blue Island & Harvey Street Railroad company was organized in November with a capital stock of $250,000, and over two and one-half miles of right of way have been secured. Beginning at the village line on the south, where the car barns of the road are to be located, the necessary amount of frontage has been secured as far north as One Hundred and Twenty-first street. The road will be built on Western avenue north to Burr Oak avenue, west on this street and north on Greenwood avenue to Morgan Park. The Harvey extension will be built on Western avenue south to One Hundred and Fifty-fourth street, and east into Harvey.

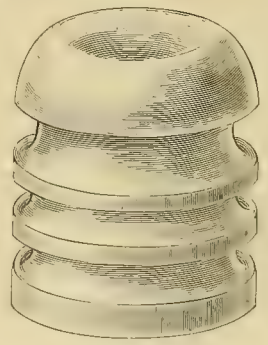
Real estate owners in all these localities are anxious to have the proposed lines built at once, as the rapid transit thus guaranteed will greatly enhance the value of this property.

Chicago and New York Telegraphers' Annual Hops.

As already announced, the telegraphers of Chicago will hold their annual ball at the Second Regiment armory, February 6. The New York telegraphers will hold their annual hop on the same evening and the committees in charge of the arrangements for the two events have concluded a novel scheme by which it is arranged to have the dances in Chicago called off by wire from New York, while the New York telegraphers, who, according to schedule, will be dancing at the same time, will have their programme directed by telegraph from Chicago.

New Porcelain Insulator.

The porcelain insulator shown in the cut is intended for out of door use, or for interior wiring where there is liability to dampness. Grooving of the outer surface, no doubt, adds somewhat to its insulating properties, but the chief advantage claimed consists in the setting of the screw head deep in the insulator; the main cause of leakage, that is a moisture circuit from wire to screw, is thus avoided. It is one of several improved insulating devices lately introduced by the Electrical Supply company, Chicago.



NEW PORCELAIN INSULATOR.

The St. Paul Strike Still On.

During the week the striking operators on the C., M. & St. P. road endeavored to get the operators who remained at their posts to join them, but failed. The places of the others were rapidly filled, and everything is moving satisfactorily so far as the railroad company is concerned. The men who are out no longer expect the management to make any overtures of peace, or grant any concessions whatever. Still they refuse to go back to work. The strike committee and the Order of Railway Telegraphers are procuring positions for them elsewhere as fast as they can and promising to keep those who fail to get situations out of want.

Chicago and Erie Telegraphers' Troubles.

Train dispatchers and conductors on the Chicago & Erie engaged in a strike last week because the company refused to reinstate C. C. Scott, a train dispatcher, who had been discharged for sending out a wrong order.

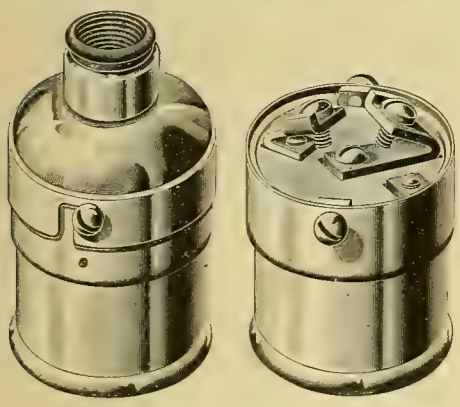
"This seems utterly absurd to me," said General Manager Tucker. "I cannot see how conductors, whose lives are dependent on the watchfulness of dispatchers, should uphold a man whose work has been marked by the most gross carelessness."

The officials of the company remained firm

in their determination not to reinstate Scott, and as he had been a conductor and was at the time of the strike secretary of the Order of Railroad Conductors and Dispatchers, it was suggested that he be given employment as a conductor. Here, too, there was an obstacle. The places of the conductors were all filled, but it was agreed that Mr. Scott should be taken in as an "extra," and given steady employment as soon as an opening presented itself.

Keyless Socket.

A new keyless socket, which has just been brought out by the Star Electrix company of Philadelphia, is shown in the cuts. The socket



NEW KEYLESS SOCKET.

is made to fit any lamp, and is constructed entirely of porcelain and brass. It is easily wired, and is very neat in appearance.

National Electric Light Association.

The committee on exhibits and transportation of the National Electric Light association has issued the following rules in relation to the electrical exhibit to be held in connection with the convention at Providence, R. I., February 17, 1891:

1. On account of the short time that the exhibition will be open, it is deemed inadvisable to formulate any arbitrary rules for the government of exhibitors. The "Golden Rule," applied in conformity with the dictates of good fellowship and common sense, is deemed amply sufficient to prevent any exhibitor from encroaching upon the rights of his neighbors, or doing anything that will detract from the general appearance of the whole exhibition.

2. The exhibition will be held in Union Hall, Broad street, diagonally opposite from the hotel, which will be the headquarters of the association, and only one block from the building in which the sessions of the association will be held.

3. The installation of exhibits may commence on Monday, February 16, and all goods must be removed from the hall by 12 M., on Saturday, February 21.

4. The several electric circuits mentioned in circular from the committee, dated December 13, 1890, will be brought into the hall on the side indicated in diagram; but the conveying of the same to different points in the hall as desired, will be at the expense of, and must be arranged for, by the exhibitors individually.

5. The committee has arranged with parties who are thoroughly competent and responsible, to attend to such business in their respective lines, as may be intrusted to them by exhibitors, at reasonable rates. Exhibitors are requested to correspond with, and give their orders direct to these parties.

6. All goods shipped for exhibition should be plainly marked with the name of the exhibitor himself; for instance, "John Smith, electrical exhibition, Union Hall, Broad street, Providence, R. I."

7. The chairman of the committee, Gen. C. H. Barney, 20 Cortlandt street, New York, will, upon application cheerfully furnish any information not included above, or explain any point not fully understood.

The following are the names of applicants for space at the Providence electric light meeting received up to January 20:

New York Insulated Wire Company, New York City; Phœnix Glass Company, New York City; Washburn & Moen Manufacturing Company, Worcester, Mass.; Electric Engineering & Supply Company, Syracuse, N. Y.; Swartz & Gannett, Providence, R. I.; The Eddy Electric Motor company, Windsor, Conn.; Jewell Belting Company, Hartford, Conn; American Electrical Works, Providence, R. I.; Jenney Electric Motor Company, Indianapolis, Ind; Interior Conduit & Insulation Company, New York City; James W. Queen & Company, Philadelphia, Pa.; Drake, Payson & Whittier, Providence, R. I.; The Okonite company, New York City; The E. S. Greeley & company, New York City; WESTERN ELECTRICIAN Chicago, Ill.; Alexander, Barney & Chapin, New York City; H. T. Paiste, Philadelphia, Pa.; The Bryant Electric company, Bridgeport, Conn.; Bernstein Electric company, Boston, Mass.; T. M. Foote Regulator company, Boston, Mass.; The Holtzer-Cabot Electric company, Boston, Mass.; John Lynch, Washington, D. C.; The C. McIntire company, Newark, N. J.; Eureka Tempered Copper company, North East, Pa.; Standard Electric Supply company, Boston, Mass.; Narragansett Electric Lighting company, Providence, R. I.; The Johns-Pratt company, Hartford, Conn.; Shultz Belting company, St. Louis, Mo.; The Walker Electric company, New York City, *Electric Power* company, New York City; *The Electrical Engineer*, New York City; *Modern Light and Heat*, Boston, Mass.; Chas. A. Schieren & company, New York City; Sperry Electric Light company, Chicago, Ill.; Thomson-Houston Electric company, Boston, Mass.; G. G. Stillman, Boston, Mass.; Electric Supply company, Chicago, Ill.

Chicago Board of Trade Telegraph Project.

There seems to be considerable clashing among the advocates of the telegraph scheme projected by the Chicago Board of Trade. No appointments have yet been made by President Baker to fill the vacancies on the telegraph committee made by the resignations of Robert Lindblom and F. G. Kammerer. The reason first advanced by the Board of Trade officials for the resignations was the arduous duties imposed upon Messrs. Lindblom, Kammerer, Richardson, Dunn and Phelps, by reason of the projected plan of building a telegraph line between the different commercial exchanges of the country.

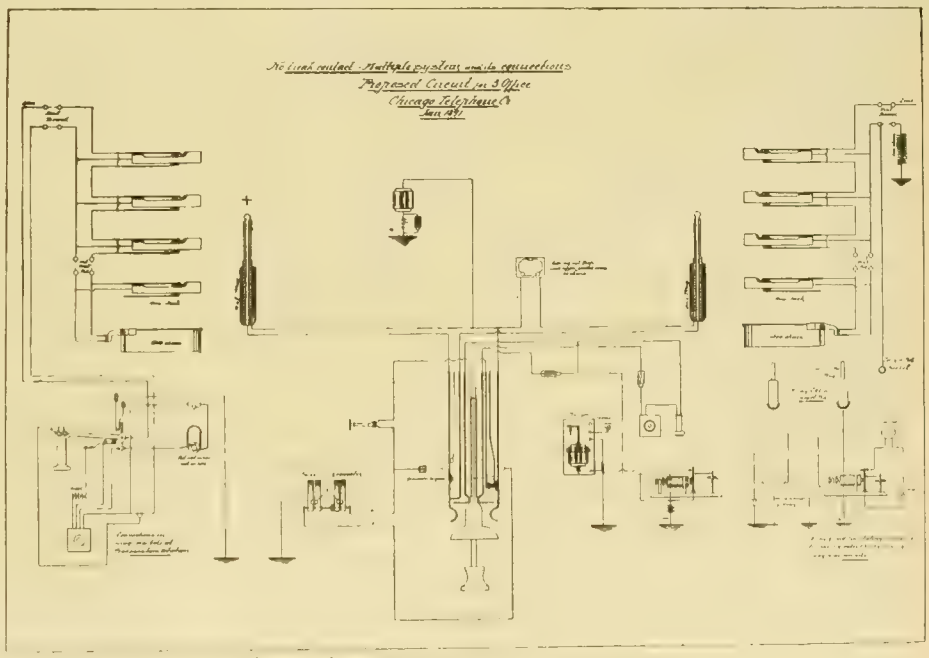
The appointments and subsequent resignations were, it is said, a continuation of the old troubles growing out of the board's market quotations being furnished outside open boards and bucket shops. The opposition to President Baker now claims that a majority antagonistic to his proposed regime were appointed on the committee to undertake a proposed plan, fraught with difficulty, with the view that the failure of the committee might reflect upon his enemies.

Mr. Lindblom, who claims the inception of the projected telegraph line, was the chairman of the committee first reporting on its entire feasibility, and it is reported he feels that certain discourtesy was shown in appointing him to a less responsible place on the committee.

With the telegraph committee rests the problem of limitation and supply of the board quotations. Both of the committeemen who resigned refuse to reconsider their action.

O'Connell's No-Break Multiple Telephone System.

When multiple telephone switch-boards are employed there has always been more or less trouble caused by dust at the contacts in the spring jacks. The object of the system illustrated in the accompanying diagram is to prevent accidental opening of lines on multiple switch-boards for metallic circuits. The changes constituting the chief features of the modified system, which is the invention of J. J. O'Connell of the Chicago Telephone company, is the use of twin alternating generators; the permanent closing of the troublesome contact in all the spring jacks; increasing the resistance of the subscribers' drops from 500 to 1,000 ohms; the grounding through the signal bell of one side of a subscriber's metallic circuit; the insertion of a "clearing-out drop" with copper-plated cores, in the connecting cord outfit at the exchange.



O'CONNELL'S NO-BREAK MULTIPLE TELEPHONE SYSTEM.

In the right hand corner of the drawing the target-board connections for the system are represented.

The busy test in the proposed system is made by reinforcing the test relay battery by the cord test battery. The touching of the test plug tip to a busy line closes the relay and brings a buzzing sound into the operator's instrument.

Line Connector.

The line connector shown in the cut consists of a short section of seamless copper tube, of oblong section, as shown in Fig. 3, of such size as to admit the two wires alongside each other from opposite ends. The ends of the connector are then grasped with clamps which are rotated in opposite directions, thereby twisting spirally the wires one on the other, and drawing the surrounding envelope of copper into absolute metallic contact with the wire. During this

FIG. 1.

FIG. 2.

FIG. 3.

NEW LINE CONNECTOR.

twisting process the wires are ground together so as to form a perfect contact. In twisting, the metal of the sleeve conforms itself to the two twisted wires, as shown in Fig. 2, and in examining a joint made with this connector, it is difficult to believe that the original section of the tube was oblong.

The joint is extremely compact. Its resistance, if anything, is less than that of an equal length of the line wire. There is no brazing nor other foreign substance to set up electrolytic action, or corrosion. It is claimed that the joint can be made in a comparatively short time and that it is unusually strong.

The clamp pinches the tube between the wires at the ends, and closes an open space there, preventing moisture from getting into the joint. Even if moisture should get in, which is not very unlikely to happen, it is stated that there will be no electrolytic action as there is no brazing about the joint. Different sized wires can be joined together without any specially formed conductor, provided the difference in size of the wires is not very great. When a joint made in this manner is cut open it is found to be almost a solid mass of copper. The connector is introduced by W. A. Giles and A. M. Hunt, U. S. N., of Newark, N. J.

The city council of Kankakee, Ill., has passed the electric street railway ordinance, and work will begin on the line as soon as material can be procured.

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J. B. O'HARA, - - - - - - - - - - }
F. L. PERRY, - - - - - - - - - - }
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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE city authorities of Pittsburg are exceedingly anxious to derive a revenue from the street car companies of the city. This anxiety has led to the conception of a plan by which electric street sweepers will be operated. It is proposed that these ponderous machines shall derive their current from the electric street railway circuits. The authorities propose to secure their power free, apparently, but it hardly seems likely that the arrangement will commend itself to the favor of the railway companies. Some of the details are mentioned in the Pittsburg letter.

FOR a long time the calcium light has been without a rival in theatrical work. But managers are constantly on the lookout for improved apparatus by which scenic effects may be made more brilliant and startling. In another column is given a description of electric lamps, which are now employed in place of calcium lights in one of Chicago's playhouses. The lamps are of the arc type, and take current from the incandescent circuit on the stage. The lamps with a resistance are connected in multiple across the mains. Not only is the light steady and silent, but the apparatus can be manipulated with the greatest ease, and without danger. The simplicity of the outfit will commend itself to the theatrical economist.

IN the Minneapolis letter this week mention is made of a law introduced in the Minnesota legislature providing that passengers who are not provided seats in street cars shall not be required to pay fare. Such a law would practically have an effect only in Minneapolis, St. Paul and Duluth. From what we know of the enterprising residents of those cities it is decidedly our opinion that they would prefer to stand in the car and maintain their equilibrium by convenient straps rather than to wait any considerable time for a car in which seats were available. The street cars in Minneapolis are perhaps not quite sufficiently numerous to meet the demand, but the railway company is doing everything in its power to provide at the earliest possible moment entirely adequate facilities.

AT THE last meeting of the American Institute of Electrical Engineers the committee appointed to report on the proper value of the henry, the proposed unit of self-induction, presented its recommendation. It suggests that the practical unit of 10^9, absolute units of inductance, be retained. This value is ordinarily expressed as a length equal to one earth's quadrant, or 1,000,000,000 centimetres. The desirability of using the henry as a unit has been ably set forth in papers recently read by A. E. Kennelly and Prof. Francis B. Crocker. The former's paper appeared in the WESTERN ELECTRICIAN of December 27th last, and the latter's in the issue of January 30th. Prof. Crocker, who is chairman of the institute committee which has just presented its report, referred in his paper to the considerations which had influenced the members in fixing the value of the henry. It was thought at one time desirable, perhaps, to give to it the value of one-thousandth of a quadrant, but it was finally considered that such a determination would be a mistake, inasmuch as it would destroy the harmony of the practical electrical unit system, as every unit in use is derived from the others by the ratio of one to one. Had the committee decided on fixing the value as one-thousandth of a quadrant, it would have been necessary to employ one-thousandth of an ohm instead of one ohm. In its report the committee states that while the value will be found too great for convenience in some cases, the average practical inductance will approximate one henry. While the committee deems this fact fortunate, it takes especial pains to state that had not this been the case, it would still have recommended the retention of the present value of the unit, so that it would not make an exception to the present method of forming units. Small values can readily be expressed in millihenrys.

THE discussion of the paper on the "Commercial Rating of Electric Generators," read by Thos. G. Grier at the last meeting of the Chicago Electric club, was interesting but one-sided. The question as to the advisability of rating the output of dynamos in watts, kilowatts, or according to the capacity of the machine in lamps, was taken up. A majority of the members who took part in the debate, favored the use of watt or kilowatt for commercial rating. The opposition contended that while it might be well to denote in this manner the capacity of incandescent machines and generators built especially for power service, an exception should be made in the case of the arc light machine. This last named type was to be rated by its capacity in lamps; in other words we should cling to the old method of rating, and continue to designate our constant current dynamos supplying arc lamps, as, say, "60-light machines," or "30-light machines." The reasons for thus rating the arc dynamo are given in full in the report of the discussion presented in this issue, and the reader will find that there were a number of interesting points brought out. Without attempting to comment at length upon the subject we may say that in our opinion an electric generator should be rated by such a unit that when the expression intended to denote capacity is employed, it will be such that there will be no chance of error due to a badly jointed circuit, perhaps, or inefficient translating devices. In other words by designating in a specification, the total capacity of a machine in watts or kilowatts, and giving the voltage or amperage, and demonstrating that it will deliver independent of the circuit, the specified number of amperes at the proper voltage, the seller discharges his obligation as far as the output of the machine is concerned. An electric generator, be it a constant potential or a constant current machine, is an apparatus designed for the purpose of delivering current at a fixed or varying pressure. We think, therefore, the first question should be whether the current and e.m.f. of the machine is as specified rather than whether the circuit and lamps are in proper condition.

A PAPER by Franklin Leonard Pope, read before the New York Electric Club at its last meeting, is presented in this issue. His subject was "Notes on the Electric Railway, Historical, Statistical and Technical." It is an able and entertaining paper, and full of information which many will be glad to secure and preserve. The article will be widely read, for it is of a popular character, and written in a style that will attract the general reader as well as those who ordinarily peruse papers treating of electrical subjects. A considerable part of Mr. Pope's paper is historical. After adverting briefly to the discoveries of Faraday and Henry he refers at length to the achievements of Thomas Davenport, the humble blacksmith, who, he says, constructed in Springfield more than half a century ago a model which was undoubtedly the first appearance of an electrical railway in the world. As his work and even his name are almost unknown at the present day, Mr. Pope relates what he has ascertained of the work of this pioneer electrician. In 1838, it is stated, Davenport operated a printing press by an electric motor, and about that time constructed motors which were admirably designed, and in essentials, even to the shunt winding, differed little from the most scientific machines constructed to-day. Davenport was a thorough believer in the idea that electricity would supersede steam. He was an enthusiast, and it was not uncommon to smile at such enthusiasts; but he was an enthusiast as all electricians are enthusiasts in that they believe the day will come when electricity can be produced directly from coal. Mr. Pope next takes up the development of dynamo-electric machines, and then modern electric railways. The credit of priority of the electric railway in its modern form he gives to Stephen D. Field, whose work is described at considerable length. The description of Field's system leads the writer of the paper to consider the conduit method of operating railways. The difficulties which have made the application of conduits impracticable for railways hitherto are summarized, and the problem is commended to inventors. The solution will amply repay any investment of labor and study, as he believes wires must disappear from thoroughfares in all larger cities. Mr. Pope discusses in an exceedingly interesting way the storage battery and overhead systems, and presents figures in regard to the cost of operation, which are probably more accurate than any which have ever before been made public. In concluding his paper Mr. Pope speaks of the possibility of the construction of underground railways in New York. The paper closes with the prophecy, "I venture here and now to predict that within the next twenty years, if not the next ten years, electrical and underground transportation will be brought to such a state of perfection that a passenger entering one of the central stations of New York may be deposited at his home station at any point within a radius of ten miles in fifteen minutes' time, and at a fare of 5 cents. And this magnificent result is to be the contribution to the convenience and the prosperity of the public of the electrical engineer." Only the merest outline of parts of the paper is presented in this paragraph. It deserves a careful perusal in its entirety.

Notes on the Electric Railway--Historical, Statistical and Technical.[1]

By Franklin Leonard Pope.

Every trade and profession has its well worn stock of traditional anecdotes, handed down from a remote antiquity, which the veterans are accustomed to relate in hours of idleness for the amazement, or the amusement, as the case may be, of the youngsters.

The telegraphic service, in which thirty years ago I was an aspiring and ambitious youthful "plug" was no exception to the rule. You will pardon me, if I recapitulate two of these ancient tales, which I tell as they were told to me, for the sake of the moral which they point

One of these stories was to the effect that an inventive genius down East, which meant Boston or beyond, had once contrived a great improvement on the telegraph as we knew it, inasmuch as by its means the telegraph operators, or any one else for that matter, could converse directly through the wire.

"A most magnificent invention," solemnly asseverated our chief operator, Jack Selden; "it was tried with perfect success between Boston and New York, but sad to say, it had to be given up, because the New York operators' breath smelt so strongly of bad whiskey." But in later days Alexander Graham Bell of Boston did actually show us how to speak through the whispering wire, and owing, let us charitably hope, to the permanent reformation of the objectionable habits of the New York operators, it did not this time "have to be given up."

The other story was about an unsophisticated old man, a shoemaker, who lived and had a little shop in Natick, between Worcester and Boston; for aught I know he may have been the original "Natick cobbler." The only son of this old man was a soldier in our army in Mexico. This was in 1848, when the telegraph was a new thing and a great mystery, and its frequent dispatches, bringing the latest news from the seat of war, kept the community in a continual state of feverish anxiety, of which in later years we all came too well to know the full meaning. One day a letter came to the shoemaker from his son, complaining of the condition of his boots, worn to shreds by long and hard marches, and wishing that he had a durable pair of paternal manufacture. Struck with a happy thought, the good old man immediately constructed a pair of his very best No. 12 cowhides, affixed a tag to them inscribed with the proper address, tied the straps together and hung the boots over the telegraph wire which passed his house. In the morning they were gone. A belated tramp had appropriated them, and with a certain sense of grim humor not unknown among these gentry, had hung his own dilapidated brogans in their place. "Look, Marthy," exclaimed the delighted cordwainer the next morning, as he gazed out of his window in the dim light of dawn, "Johnny has got his new boots so quick, and has sent his old ones back by telegraph to be mended."

But to-day, the improbable romance of the talking wire, and the imagined electrical transportation of the simple cobbler of Natick, have both become realities. The speaking telephone is found in every business office and in almost every home. Freight and passengers are hauled over elevated ways by invisible electric power, and probably no one in this audience entertains a doubt that the day is close at hand when the electric transportation of passengers will be conducted at a rate of speed which most people now deem almost inconceivable.

Every consideration of common humanity, not to speak of public convenience and economy, unite to urge the speediest possible substitution of mechanical for horse power on our numerous street railways, and this is, for many reasons, especially to be desired in cities in which the most desirable residential neighborhoods can be reached only by routes including long and comparatively steep ascending grades. It is but just to the street railway managers of the United States to say that these considerations have not been without effect.

It is only six years ago that an electric street railway was put in actual commercial service in the United States for the first time. This was in the city of Cleveland, O. To-day considerably more than one-third of the total street railway mileage of the United States is either operated by electric power or contracts have been entered into for the substitution of an electric equipment for that now in use, at the earliest possible moment.

At a meeting of the American Street Railway association, held in Washington, only a little more than two years ago, almost the sole subject of discussion was the question of improved motive power for street railway service. Every manager and superintendent present realized that the demands of traffic were rapidly outgrowing the existing methods, and many of them had begun to look forward to the application of electric power as the only possible solution of the problem. As one delegate after another reported his experiences and observations in respect to electric traction, a member who had listened to it all with evident impatience, arose and entered his solemn protest against all the new-fangled talk about electricity. He said that he had come there upon the assumption that it was a horse railroad convention, in order to get information about horses. He wanted to know how to shoe them, how to feed them, and how to work them to the best advantage. And as he continued to complain, it was evident that in more than one place in the assemblage his ideas met with a sympathetic response.

Less than four months ago, the same association held its annual meeting at Buffalo, and in his opening address, the president, Thomas Lowry of Minneapolis, made the following significant remark:

"I am so thoroughly convinced that electricity is the coming power for street railways (except on very heavy grades, where the cable is best suited), and that it will prove so effective as a means for rapid transit for cities, that I believe that this is the last convention that will ever seriously consider horses for the operation of street railways."

[1] Read before the New York Electrical Club, January 22, 1891.

Nor was this all. Many of you who are familiar with the fact that President Lowry, whose energy, ability and foresight will never be questioned by any one familiar with his career, threw away, in 1889, a bran new cable plant, which cost nearly half a million dollars, in order to replace it with electric motors.

Some of his associates undoubtedly entertained great doubts of his sanity, but every new electric road brings a fresh tribute of approval to his enterprise and to his courage. Since he took that memorable action, electricity has changed the whole aspect, both scientific and commercial, of municipal transportation.

Few people have any conception of the enormous extent of city and suburban traffic in the cities of the United States. A few statistics are more impressive than pages of rhetoric.

The official returns show that during the year ending September 30, 1889, the 110 street railways in the state of New York, carried over 686,000,000 passengers, or 100 times the total population In New York city alone the surface and the elevated roads carried together about 400,000,000. In Boston 100,000,000, and in Philadelphia 150,000,000 passengers were carried. In fact, statistics indicate that the street railways of the United States carry something like twice as many passengers as all the steam roads and moreover, it has also been found that the number of passengers increases from year to year in a much greater ratio than the population, which means, not only that more people ride, but that the same people ride more frequently each succeeding year.

The transportation of this enormous number of passengers, probably not less than four or five billions, taking the whole country together, with safety, comfort, speed and economy, must be recognized as an undertaking of the most gigantic description. It is well worth our efforts to carefully consider the best means by which it can be accomplished. No work has ever been done by the inventor, the engineer or the electrician, of such immediate and direct benefit to the masses, as that which has to do with the subject under consideration.

Considered in a general sense, the electric car is a self propelling vehicle, the actuating force of which is derived from an electric current through the agency of an electric engine, or as it is technically termed, a motor. We may conveniently consider the subject of electric railways by dividing them into three classes, which are distinguished from each other in the manner in which the current is supplied to the motor upon the car. These are:

First. The so-called *overhead* system, in which the electric current is supplied to the car through a wire suspended above the track.

Second. The *underground* system, in which a supply conductor is placed in a conduit beneath the surface of the street, and the current is taken into the car by an arm projecting downward through a slot in the top of the conduit.

Third. The *storage battery* system, in which the current is furnished by storage batteries (which are in fact a species of electrical reservoirs) placed underneath the seats of the car and charged at the terminal station with a sufficient quantity of electricity for each trip.

While differing from each other in respect to the manner in which the current is supplied, certain essential principles are common to them all. In all electric cars, the motor is composed of a stationary portion called the *field magnet* and a moving portion called the *armature*. The electric current causes the armatures to revolve, and the armatures being geared to the car axles move the car. The driver starts the car by establishing an electrical connection between the motor and the electric conductor, overhead or underground, or the storage battery, as the case may be, stops the car by interrupting the electric connection, and reverses it by reversing the direction of the current which passes through the motor.

The time which I have allowed myself will not permit me to enter as fully as I should like into the history of the electric motor, but there are certain prominent epochs in its development, which require a passing notice.

The discovery that it is possible to produce continuous mechanical motion by the agency of the electric current, is due to an eminent English philosopher. It was made early on the morning of December 25th, 1821. For many years the discovery was regarded as nothing more than an interesting philosophical experiment, but the world is now awakening to some adequate conception of the magnificent possibilities of the humble gift which was slipped into its stocking on that Christmas morning, by one who had not long before jocosely described himself as "Michael Faraday, late bookbinders' apprentice, now turned philosopher."

In 1831, Joseph Henry, then professor of Natural Philosophy in the Academy at Albany, N. Y., and afterward the distinguished secretary of the Smithsonian Institute at Washington, in a letter to Professor Silliman, of New Haven, said: "I have lately succeeded in producing motion by a little machine which I believe has never before been applied in mechanics, by magnetic attraction and repulsion." This was a crude and simple affair, but served sufficiently to illustrate the principle of such apparatus. Those who are interested to see it will find it carefully preserved in the cabinet of Princeton College.

After having thus demonstrated the possibility of constructing an electro-magnetic engine, so far from giving way to the natural enthusiasm of the successful inventor, Henry proceeded, with that calm sobriety of judgment for which he was peculiarly distinguished, to forecast the future possibilities of the new motor. He was soon led to see under the conditions of knowledge then existing the power could only be derived from the oxidation of zinc in a galvanic battery, and hence the heat energy required in the original smelting of the metal must represent at least an equal amount of power. Hence his conclusion that the fuel required for that purpose might with better advantage be employed directly in performing the required work.

While feeling thus assured that electricity could not hope to compete with, much less to supersede, steam, as a primary source of power, Henry, nevertheless, did not hesitate to predict that the electric motor was destined in the future to occupy an extensive field of usefulness, particularly in applications in which absolutely theoretical economy was subordinate to more important considerations.

Time has shown that Henry's conception of the legitimate field of the electric motor was prophetically accurate, but his views failed to impress themselves upon the minds of his contemporaries. In the expectation that electricity would soon be the universal motive power, the problem of its utilization was, during the next ten years, attacked with great zeal by a considerable number of inventors. The earliest as well as the most meritorious of these was a Green Mountain village blacksmith by the name of Thomas Davenport. Some time since, while preparing a lecture to be delivered before the Board of Trade in Springfield, Mass., I accidentally learned that this inventor had constructed a model of an electric railway in Springfield more than 50 years ago, undoubtedly the very first appearance of the electric railway in the history of the world. The work of this pioneer electrician, and even his very name, being almost unknown to the present generation of laborers in this fertile field, my curiosity and interest were sufficiently excited to lead me to undertake an investigation with a view to rescue whatever knowledge of his work had escaped the ravages of time. In this it has been my fortune to meet with an unexpected degree of success. The record of his career shows that Thomas Davenport was a man of no ordinary merit. Pursuing the occupation of a village blacksmith in Brandon, Vt., at that time an obscure country town, far removed from all main lines of travel and transportation, and long before the day of railroads, but as Prof. Eaton justly said of him, "possessing one of those minds which cannot be confined to the limits of a blacksmith's shop nor any other shop less than the canopy of heaven," he had no sooner been shown as a curiosity the effect of Professor Henry's electro-magnet in lifting a blacksmith's anvil by the magnetic power generated by three small battery cells, then he was seized with the idea that electro-magnetism might be applied to the propulsion of all kinds of machinery, and in fact be made a universal motive power. From that moment his whole life was devoted solely to the realization of this conception.

It has been well said that "to rightly appreciate a discoverer we should not look at his work from our time; we should not judge of his work in the fullness of the light of present knowledge; but in the dim twilight which alone illuminated to him facts and laws then but imperfectly known." We must remember that at that date the steam engine was a comparatively uneconomical, inefficient and dangerous apparatus, and was regarded at best but a necessary evil; a thing to be tolerated and endured in the absence of available water power, but best dispensed with altogether wherever possible. At that date and for years afterward the annual catalogue of disasters by fire and explosion due to the use of steam, was a lengthy and horrifying one. The report of a single year of the St. Louis Board of Trade gave a list of no less than 112 steamers which had been destroyed on the Western rivers within the preceding twelve months by fire and explosion. Many people now living will remember the circumstance of over sixty persons being killed by the bursting of a steam boiler in the heart of the business district of New York City. With such facts as these in mind it is easy to understand why the possibility of a new motor, compact, noiseless, manageable, free from all danger of fire and explosion, should be hailed with enthusiasm as a priceless boon to the industrial community. We must remember, too, that there existed at that time no data from which could be foreseen or determined, even with remote approximation the relative economy of steam and galvanic power. It was not until ten years later that the great law of the conservation of energy and the correlation of the physical forces—now familiar to every schoolboy—was first formulated by Grove and Mayer and Joule; a law now so interwoven with our scientific conceptions that it is hardly possible for us to imagine that it could ever have been unknown. At a much later date than that of which I am now speaking, men whose names will be recognized as the foremost scientists of the time, such men as Lardner, Jaocbi and Joule, did not hesitate to put upon record the belief that within a few years the power of steam would be wholly superseded by that of electro-magnetism, and the *Scientific American* was publishing illustrated descriptions of perpetual motion machines.

From the moment in which he first witnessed the experiment of lifting an anvil by Henry's electro-magnet to the very last hour of his life, Davenport never once wavered in his belief that steam was ultimately destined to be supplanted by elecro-magnetism. Within six months from that time, with the assistance of another mechanic of the same town, he succeeded in constructing a machine by which he obtained continuous rotation by electro-magnetic power. And it is worthy of remark that in this very first machine, Davenport exhibited that unerring instinct of genius which ever distinguishes the true inventor, in that he grasped at once the fundamental conception of the combination of fixed and rotating electro-magnets, the one reversible and the other non-reversible, which has characterized every commercially successful electric motor from the beginning until the present day. Time does not permit the rehearsal of the detailed story of his struggles, his failures and his successes During the six years between 1835 and 1841, he built more than 100 operative electric motors, scarcely any two of which were of the same design, and which varied in size from a small model up to an engine capable of driving a rotary printing press for twelve hours in succession. In December, 1835, he exhibited in Boston, the model of an electric locomotive and circular railway which he had built in Springfield, and a similar though more finely finished model which was built by him the following year is still in existence in a good state of preservation. He published in 1840, now more than fifty years

ago, in the city of New York, a weekly journal called the *Electro Magnet and Mechanics' Intelligencer*, which was printed upon a press driven by an electro-magnetic engine. Some of his motors, constructed as early as 1837 and 1838, were admirably designed and in essentials, even to the shunt winding, differed but little from some of the most advanced and successful types in use at the present day.

Less than a year before his death, upon reading a newspaper account of the trial of the large engine built at Washington by Prof. Page under an appropriation from congress, Davenport wrote a long and interesting letter to a local newspaper, congratulating Professor Page upon his success, giving a concise and full account of his own work, and predicting with earnestness born of entire conviction, the ultimate triumph of electro-magnetism over steam.

It has been the fashion to smile at such men as Davenport as enthusiasts. But may it not be that there is another side to the question? I do not forget that one of the greatest of American philosophers, Joseph Henry, has said: "The man of true genius never lives before his time. Though he may catch a glimpse of the coming light as it gilds the mountain top, long before it has reached the eyes of his contemporaries, and though he may hazard a prediction as to the future, he acts with the present." Viewed in this light, it may be said that Davenport did not live before his time At least he *acted* with the present. It may be affirmed with entire truth, that he gave every effort of his life to the development of his idea, and at last sunk into his grave, as he himself well realized, a victim of disappointed hopes. Yet, if Davenport was an enthusiast, so are we all enthusiasts as respects our anticipations of the realization of the result which he predicted and for which he wrought unceasingly. Steam is nothing more than a convenient agency for the *transmission* of power, which derives its energy from heat and imparts it to mechanism. So soon as the great riddle of the day has been read—the production of electricity, as steam is produced, directly from heat—then, indeed, will the predicted triumph of electro-magnetism over steam become an accomplished fact. Forty years have passed away since all that was mortal of Thomas Davenport was laid to rest beneath the Brandon elms, yet I think there are not many present in this audience to-night who do not cherish the expectation, if not the conviction, that before the half century has been completed the great problem will have been solved, and the era of a new industrial revolution will have dawned upon the world.

The electric locomotive constructed by Prof. George G. Page, which was tried by him on the Baltimore & Ohio Railroad, in 1851, deserves a passing notice here. It was a noteworthy achievement, but developed no new principle, nor did it contribute anything to the ultimate solution of the problem of the electric railway. Many other promising experiments were made, but all resulted in failure, until the very name of electro-magnetic motor became almost a synonym for "humbug." In discussing the question Professr Henry once said in his prophetic way:

"All attempts to substitute electricity or magnetism for coal-power must be unsuccessful, since these powers tend to an equilibrium from which they can only be disturbed by the application of another power which is the equivalent of that which they can subsequently exhibit. They are however, of great importance as intermediate agents in the application of the power of heat as derived from combustion. Science does not indicate in the slightest degree the possibility of the discovery of a new primary power comparable with that of combustion as exhibited in the burning of coal. We, therefore, do not hesitate to say that all declarations of the discovery of a new motive power which is to supersede the use of coal, have their origin in ignorance or deception, and frequently in both."

I wish to call your particular attention to the remarks of Henry in the paragraph just quoted, that electricity and magnetism are of great importance as *intermediate agents* in the application of the power of heat.

In these words Henry accurately foretold the true place of the electric motor in the domain of industry. Not a little confusion of thought exists at the present time in reference to this very point. Every day we hear somebody speak of electricity as if it were a primary motive power.

It only requires a moment's consideration to see that such a view is wholly without scientific basis. Electricity is not a source of power. What, then, I hear the layman ask, is electricity? Those of us who are most familiar with it, have but one answer to that question: *We do not know*; and for my own part, I very much doubt if we ever shall know. This much, however, is certain, electricity is a very convenient and very manageable agency, perhaps a peculiar form of matter, perhaps a peculiar form of energy, by which any quantity of mechanical power may be instantly transferred from a prime motor, such as a steam engine or water-wheel, to a secondary motor at a distance, which is employed to do the required work. It really performs exactly the same office, which, however useful in *conveying* mechanical power from one point to another can, under no conceivable circumstances, be capable of *originating* it.

The electric motor, therefore, remained, for something like forty years after its invention, an interesting, but practically useless philosophical toy. It was like half a pair of scissors—of no earthly use without the other half. The other thing that was needed was an organized machine, which could convert large quantities of mechanical power into electricity. The discovery that it was possible to effect this conversion was also due to Faraday. With his usual sagacity, he had suspected that it might be done, and undertook a series of experiments for the express purpose of finding out. On the second day he wrote to a friend: "I think I have got hold of a good thing, but cannot say; it may be weed instead of a fish, which, after all my labor, I may pull up." On the tenth day he pulled it up and it was a *fish*; it was not a small fish either. He had made a discovery which, without injustice, may fairly be compared to Newton's immortal discovery of gravitation. But Faraday was a man who possessed pre-eminently the scientific mind. His delight in the pursuit and detection of the great truths of nature was so intense and so absorbing, that he was never able to turn from them for the purpose of following up their practical application. "I have rather been desirous," he once wrote, "of discovering new facts and new relations dependent on magneto induction, than of exalting the force of those already obtained, being sure that the latter would find their full development hereafter."

This was the beginning of the development of the magneto-electric generator. The next step is due to the genius of another American scientist and inventor, one whose name will occupy a far more prominent position in the annals of American science a century hence than it does to-day, Moses G Farmer He, it was, who in 1867, in a letter to Henry Wilde of Manchester, England, first described the principle of the modern dynamo-electric machine, and explained to him why the principle of its action was not like that of "a man lifting himself over the fence by the straps of his boots," as he humorously expressed it.

Almost at the same time similar machines were independently invented by Wheatstone and Varley in England, and Dr. Siemens in Berlin. The invention of the dynamo-electric machine gave a wonderful impetus to the investigation of every branch of electric science The subject was taken up by scores of enthusiastic workers in all parts of the world; improvement succeeded improvement, until we have as a result the exquisitely organized dynamo-electric machine of to-day, a machine which is admitted to have reached a perfection and efficiency which leaves but the narrowest margin for further improvement.

The earliest field of usefulness of the dynamo machine was found in electric arc lighting, which has become in the United States an immense industry One of the most effective of the early machines was designed by Gramme of Paris, in 1872, and a number of them were shown by him at an industrial exhibition at Vienna, in the following year. Here occurred one of those extraordinary fortunate incidents, which again and again have played such a prominent part in the history of industrial progress. In making the electrical connections to one of these machines, not yet belted to the engine shaft, a careless workman attached to it by mistake a pair of wires which were already connected with another dynamo machine which was in rapid motion. To the utter amazement of this worthy artisan, the second machine instantly commenced to revolve with great rapidity in a reverse direction. When the attention of Gramme was called to this phenomenon, he saw at once that the second dynamo was performing the function of a motor, and that what was taking place was the actual transference of mechanical power through a small wire by the means of electricity. This singularly opportune occurrence being commented upon in the scientific journals, led to the almost instant recognition of the true place of the electric motor in the domain of mechanics. The late Professor Maxwell, one of the master minds among electricians of the new era, expressed the opinion that the reversibility of the dynamo machine was the most important discovery of modern times.

The principle of converting mechanical energy into electricity and reconverting this by a reversed dynamo into mechanical power, naturally suggested the practicability of transmitting power through electric wires to any required distance. One of the earliest results of this conception was the revival of the electrically operated railway, the commercial development of which had necessarily remained in abeyance until machinery was available for furnishing large quantities of electricity at a moderate cost.

One fact of controlling importance in this connection is that electricity is capable of being supplied to a moving motor through a frictional or rolling contact; a method of communicating mechanical power impossible of realization by any other known means. Hence the possibility of supplying a power by machinery situated at any required distance from the moving train by extending the conductor to and along the railway.

The credit of priority in the invention of the electric railway in its modern form—that is to say, the moving electromotor on the car connected by electric conductors with a stationary dynamo—I believe to be justly due to Stephen D. Field, now of Stockbridge, Mass., who was living in San Francisco in 1877. This was about the time of the introduction of the cable system of street railways, which was resorted to in San Francisco, for the reason that some of the grades were so excessive that the use of horse power was absolutely out of the question. Observing the operation of the cable road, it at once occurred to Field that electric power might be applied to the same purpose with as great or even greater advantage. At that time no dynamo-electric machines suitable for this purpose were to be had in the United States, and he accordingly ordered one from Europe for experimental purposes. It took a long time to make it, but at last it was completed and shipped to San Francisco by a sailing vessel. The vessel was wrecked on the voyage, and the machine went to the bottom of the sea. Not yet discouraged, he ordered another one, which eventually reached him in good order, and enabled him to commence his long delayed experiments. He tried first an electric elevator, in which he was successful In 1879, having exhausted his resources, he came to New York, bringing with him his plans, with which he hoped to enlist capital to continue his work. He laid these plans before me, and being impressed with the entire practicability of his scheme, I gave him every encouragement in my power. The plan which he had devised contemplated the closing of the conducting wire in a conduit beneath the street. He was not successful in obtaining sufficient means to properly develop his invention: he became involved in tedious, harassing and expensive litigation with wealthy corporations, and his health failed him at a critical time, so that for years he was incapacitated from active work, but the single railway which is in operation in this country to-day, and embodies his matured conceptions, is regarded by competent judges as in many respects superior to any yet brought before the public. Field's electric locomotive was first exhibited at the exhibition of railway appliances in Chicago in 1883, during the continuance of which 27,000 passengers were transported by it.

In the summer of 1882, Dr. Joseph R. Finney exhibited in Allegheny, Pa., an electric street car, for which the current was supplied by a copper wire about the thickness of a lead pencil, 15 or 20 feet above the street. A small trolley fitted with grooved wheels, running on this wire as on a track, and connected with the car as by a flexible conducting cord, served to convey the electric current from the suspended conductor to the motor. Some of the earliest of the successful lines in this country were arranged upon this plan. At a later date this was superseded by the type of contact wheel now in general use, which runs underneath the wire and is mounted upon the end of a long yielding rod bearing a certain resemblance to a fish-pole supported upon the roof of the car.

I have said that the original invention of Field contemplated the supply of electricity to the traveling car from conductors inclosed in a conduit beneath the pavement. He as well as many other inventors, appreciating the force of that prejudice which undoubtedly exists—among newspaper editors—against any avoidable multiplication of overhead electric wires in the streets realized that the great prize to be sought for above all others, was the invention of a system of electrical supply which should dispense altogether with the overhead line. Hosts of inventors have diligently wrought for ten years upon this most difficult problem. Hundreds of patents have been taken out, and more than a million dollars have been disbursed in paying for tuition in the costly school of experience. More than once, and in more than one direction, success has at times seemed almost certain; yet truth compels me to say that from the hard practical standpoint of dollars and cents, by which every invention must first or last be tried, the net outcome of all this vast expenditure of labor, time and money, has, up to the present moment, been almost insignificant. The reward which awaits the fortunate person who succeeds in completely solving this problem may well be regarded as a potentiality of wealth beyond the dreams of avarice.

The problem of the underground conduit does not at first sight appear to be a very difficult one. It renders necessary, in the first place, a construction which will effectually resist the action of forces tending to disturb the condition of the wires, and with the heavy traffic on the streets this involves a very strong structure. It is absolutely necessary that the conductors shall remain insulated from each other and from the ground, under all conditions of weather. The exigencies of heavy rains and snows necessitate a construction which shall permit of a thorough insulation of the conductors and a drainage of the entire system. There are other minor points which require to be taken into consideration. Without going into details, it is sufficient to say that the conduit system has been tried on an extensive scale in Denver, Cleveland and Boston, and to a lesser extent in several other places, but in every case the continual interference and interruptions consequent upon its use, have exhausted the patience of the traveling public and compelled its abandonment. I do not wish for one moment to convey the impression that the problem is an insoluble one. My attitude is rather that which was taken by Professor Tyndall some ten years ago upon the question of the practicability of domestic electric lighting by incandescence. He had no doubt that the problem would be solved, but it was a great satisfaction to him to know that it would have to be done by somebody other than himself. I may, perhaps, say that I think great progress has been made in this direction within the past year, and I cannot but feel that the disappearance of the overhead system from the streets of all our larger cities and towns is only a question of time, although the objections which have been most strenuously made to its introduction are for the most part, rather of a sentimental than of a practical character.

The storage battery system, both from the standpoint of the public and of the street car manager, is an ideal solution of the problem of electrical transportation. It has many features which especially commend it for city work. Each car is an independent unit, and hence no accident can materially cripple a well-organized system. The idea of being able to store a large quantity of electricity in a box under the seats of a car, to carry it round, and to draw from it a large amount of power, as required, is a most attractive one. Storage battery cars can be introduced in the existing systems, one car at a time. In cases of emergency they can be run over almost any route where a horse car can be run, not being restricted to the route of an electric conductor, and under ordinary circumstances the car can be run just as rapidly, and controlled just as effectively as it can be with the trolley system.

All these advantages were recognized at an early day, and hardly had the storage battery been invented before it was applied to street car propulsion. The first storage car was operated in Paris, in 1882. The system was put in practical service on one of the lines in Brussels, Belgium, and continued for two years It was also introduced in 1886, on the Madison avenue line in New York City, and has been in operation there ever since. The results of the ten cars now running on the Madison avenue line appears to have demonstrated that the system may, with careful management, be made thoroughly reliable. Each car will carry a full load on a straight and level track, 15 miles per hour, and will ascend grades not exceeding 5 per cent., and not more than 500 feet long, at five miles per hour. A run of 40 miles can be made on a level track, which is considered half a day's work, with one charge of battery. The time required to replace the exhausted batteries with fresh ones, is not more than two minutes. There are, however, two serious objections to this system which have thus far been sufficient to prevent its adoption in other than exceptional cases. One of these is the great weight of the batteries, and the other is the lack of reserve power in the emergencies which sometimes occur. In other words, two considerations enter into the question, one of economy and the other of efficiency.

To take up the question of comparative efficiency first,

a very little consideration of the matter will show that the progress of the art so far as yet developed, practically limits the use of storage battery cars to lines having very light grades—not more than 5 per cent. at the outside. Very many of our Eastern cities, for instance, Springfield, Providence, Worcester, Albany, Troy and many others which I might mention, have very severe grades, from 7 to 10 per cent, and some of them half a mile long To start a heavily loaded car in bad weather on such a grade as this, means an expenditure for a few seconds of from 50 to 80 horse power. Experience has shown that this is far too heavy a tax upon the powers of a storage battery. Even on comparatively level lines, in our northern climates, the occurrence of a heavy storm of snow or sleet necessitates the expenditure of an abnormal amount of power, and it is on just such occasions as these, when everybody wants to ride, so that the cars are loaded to their utmost capacity, and great dissatisfaction prevails if there is any delay, or any lack of sufficient accommodation. It is at such times as this that the advantages of a distribution from a central station are most apparent The whole number of cars or extra ones, if necessary, can be run, and any amount of power required to force them through obstructions and to keep them running on schedule time can be supplied from the power station. It is merely a question of burning more coal.

Considering the economical aspect of the question, first, as to the original cost, it may be said roughly, the difference between the storage and overhead line system is not very great. The whole outfit, exclusive of road bed, track and building, for either system, will aggregate perhaps $10,000 per car. Now as to the cost of maintenance and operation:

A 16 foot car with two motors, such as are most commonly used, will weigh 8,000 lbs., of which 4,000 is electric apparatus

A storage battery car of the same size and capacity weighs 14 000 lbs., of which 3,800 is battery.

A full load may be estimated at 30 passengers, weighing about 4,000 lbs

It will be seen that the storage battery car weighs nearly as much as two ordinary electric cars. It seems at present impracticable to operate a car with less than 3,800 lbs. weight of battery, and unless great improvements are made, there is little reason to hope that this weight can be materially reduced.

What is termed the *commercial efficiency* of an electric railway is the ratio between the power generated by the steam engine and that exerted by the car wheels. We may call the weight of the car body and truck, plus the full load of passengers, the *useful load.*

The best authorities seem to concur in the opinion that it requires, roughly speaking, nearly twice as much power per unit of useful work done, with the storage battery system, that it does with the direct distribution system. The dead weight of the battery is nearly equal to that of a paying load of 30 passengers, and this load must be transported whether there are any passengers or not. The increased weight adds to the cost of renewal and repairs, both of the track and of the cars

The cost of horse power for drawing cars has been found by long experience to vary from 10 to 11 cents per car per mile. The cost of power for the ten storage battery cars on the Madison avenue line in New York is said to figure out 10 6 cents per car per mile, practically the same as horse power.

A careful computation of the average cost of power by the direct distribution system, on a considerable number of different lines in this country, shows that the cost for coal, attendance, real e tate, oil and waste, repairs of machinery and line, foots up 5.09 cents per car per mile.

You will bear in mind that I am now speaking solely of the cost of *power;* the greater part of the expenses of any street railway company remains substantially unchanged whatever kind of power is used.

We often hear people say, "What difference does it make to me how much the power costs the railroad company. We pay five cents per trip, no more, no less." It is only a question of increasing or diminishing the profits of the corporation. But this is a very short-sighted way to look at the question, Increased economy in conducting transportation means more frequent and less crowded cars, greater speed, more branch lines, and better accommodations in every way. You still have to pay your five cents, it is true, but you must remember that you get a great deal more for your money.

I once had occasion to study this whole question very minutely. In the fall of 1886, when the West End Street Railway company, of Boston, was first organized, I was commissioned by President Whitney to make for him a careful investigation of the subject of electric propulsion, which he desired to apply to the entire street railway system of Boston. It was a gigantic proposition, for at that date there was hardly a dozen electric street cars running in this country. I was told by him at the outset that I must confine my researches to conduit and storage systems; that anything in the shape of an overhead line was out of the question and would never be tolerated in Boston for a moment. I submitted my report to Mr. Whitney on the 30th day of April, 1887. At that time no experience had been gained which would enable me to compute accurately the cost of operation of the different systems, but the final result of my estimate then given to Mr. Whitney, of the cost of power per car per mile, was as follows:

Horse power	11.07 cents
Electric storage system	7.34 "
Electric underground distribution	6.02 "
Electric overhead distribution	3 28 "

It will be seen that these figures estimated the cost of the storage system as a little over twice that of the overhead system Experience has confirmed the substantial accuracy of my original estimate in respect to relative cost. The absolute cost of all electric systems is considerably greater than was anticipated. This is partly due to the item of repairs for the electric motor and gearing, which are found to be subject to much greater wear and tear than experience had given reason to anticipate, and partly to the great increase in the number of passengers per car mile, caused by the popularity of the electric cars, which adds greatly to the loads carried.

Mr. Whitney then authorized me to construct an electric car operated by storage batteries, and to give the practicability of the scheme a thorough test This pioneer car, the very first electric car of the West End company, was put in service in the early part of October, 1887, and was run for some time between Cambridge and Boston. A careful series of tests and measurements showed the cost of operation to be about the same as that of a horse car of equal capacity The West End company continued to experiment, putting down the next year an expensive conduit line on Boylston street, in Boston, and an overhead line on the extension of Beacon street in Brookline. The comparative results of the practical trial of the three systems was so favorable to the overhead line, that the objections of the citizens of Boston were gradually overcome, and at length overhead wires were permitted to be placed in the streets of the city proper.

Finally, I proposed to consider the question whether there are any valid reasons why the public should object to the introduction of electric railways, or why the municipal authorities should hesitate to grant the necessary franchises?

Are electric railways dangerous?

With a view of getting at the actual facts in the case, the *Boston Advertiser*, a few months ago, sent out a circular letter asking information from every city in which electric railways are in actual operation from Portland, Me., to Galveston, Tex. It was asked what system was used in each place; whether there ever had been loss of life or injury from the wires; whether there was any serious objection on the part of the public to overhead wires, and what was the general opinion in the locality as to the effect of the introduction of electricity upon the street railway service? Replies were published from 64 cities and towns. All but four of them were favorable Not one solitary instance of accident or serious injury from electric currents was reported. One of the objecting places was Newport, R. I., where it seems the "upper ten" strenuously opposed the introduction of anything that would popularize riding on the streets

An extraordinary amount of nonsense has been printed and talked in respect to the alleged dangers of both electric light and railway wires. The public have been needlessly alarmed by the exaggerated statements of interested parties but nevertheless, the danger is so small, as a matter of fact, that the actual figures are almost astonishing. Most of the accidents which have been reported occurred in New York city. Yet the statistics show that in 1889, out of 1,467 deaths in New York City, by accidents of various sorts, only *nine* were due to electricity, a considerable less number than were killed by being run over by horse cars. Not a single death was recorded in Boston, although there are perhaps more wires there in proportion to the population than in New York. There are in the six New England States nearly 140 arc light stations, burning over 20,000 arc lamps and distributing 30,000 horse-power of electric energy through the streets of the principal cities and towns. During the last ten years, so far as I can ascertain, there have been *five* deaths from electricity; four of these were employes of the lighting companies, and one was a careless boy who climbed upon a shed and took hold of a wire. During the same ten years the steam railroads of New England have killed 2,339 employes and 2,902 other persons—5,241 against 5. Not only is electrical power far less dangerous than the same quantity of power used in other industries, but it is relatively safer, as the few accidents that do occur, are among the employes. These remarks refer to electric wires in general. Now as to electric railway wires.

I believe that it is an incontestable fact that not one single man, woman or child has ever been killed or even seriously injured by a 500 volt current, which is the highest pressure ever permitted upon electric railway wires. Every alleged case of accident by railway wires has, upon investigation, proved to be either without foundation, or to have been caused by an electric light current When we consider that shocks have been experienced by men, women and children; persons of all ages and all sorts of physical condition, sometimes for a period of several minutes, experience seems to warrant the positive assertion that the electric railway current is not dangerous to human life, and that we may dismiss that question from further consideration.

Many persons are alarmed at the vivid flashes of light which are often seen at night beneath the wheels of an electric car, and at the point of contact of the trolley wheel with the overhead wire, and are under the impression that they must indicate a very dangerous electric pressure. Such, however, is not the case. In an electroplating establishment at Ansonia, Conn, I once saw a workman accidentally set a tin pail filled with water upon a pair of electric conductors near the dynamo. The pail instantly disappeared, being not merely melted, but being converted into metallic vapor, with a terrific flash which illuminated the whole building with a dazzling and instantaneous radiance; yet the current which produced this startling phenomenon was of such low pressure that it was impossible to detect its presence by the sense of touch, even by applying the hands directly to the bare conductors.

The average speed of the horse car is about six miles per hour. The question is sometimes asked, How fast may electric cars be safely run in a city street? One fact within my own knowledge will go far to answer this question. There is a heavily traveled street in Pittsburg only thirty-six feet wide, containing a double track cable road, which leaves not more than nine feet space on each side. At first the cable cars were run at the rate of seven miles per hour; afterward the speed was increased to nine and one half miles per hour. The records show that there are not so many accidents under the present arrangement as there were before Pedestrians and drivers are more careful and take fewer chances. The schedule rate of the electric cars in Cleveland is nine miles per hour, and in some parts of Boston as high as twelve. The value of an electric railway to the public is largely determined by its speed, but the economical aspect of the question is equally important. If we make six miles per hour with horses, and nine with electricity, each car does fifty per cent. more work without increased expense for conductors' and drivers' wages, which is an importent item. Another economical feature due to the use of electricity, is the ability to haul one, or even two, tow cars without loss of schedule time on special occasions when the traffic is unusally great.

Nothing is more astonishing than the capacity of the electric cars to make their schedule time in the face of the heavy storms of a New England winter. It is a common sight to see an electric car running apparently with perfect ease, up a heavy grade through snow a foot deep, pushing or pulling other cars loaded to their utmost capacity.

The total number of electric cars now running in this country is probably between 2,500 and 3,000. Of the whole number I presume not more than thirty or forty are operated by storage batteries. The fact that the overhead system, though introduced at a later period than either the storage system or the underground distribution system, has so far surpassed them both, goes far to show that as yet it is the only system which has been able to meet the various exacting requirements of our street railway service

I regret that the necessary limitation of time does not permit me to mention more at length the work of other American inventors, to whom the development of the electric railway is largely indebted. Among them are Charles J Van Depoele of Chicago, now with the Thomson-Houston company at Lynn, who exhibited a car in operation in Chicago, in 1883; Leo Daft, whose motor drew a full sized passenger car over the Mt. MacGregor railway at Saratoga, in 1883; and especially, Lieutenant Frank J. Sprague who designed carried out and completed the first installation of electric railroading on a large scale in the world in Richmond, Va., in 1888. This was a road 12 miles in length, with a great number of curves, a bad track, numerous grades of 10 per cent. and over, and an equipment of 40 motor cars. Laboring under enormous difficulties and drawbacks, Lieutenant Sprague succeeded, by the completion and operation of this plant, in establishing, beyond peradventure, the future supremacy of the electric street railway, and many of the characteristic features at that time designed and introduced by him have practically become standards in the modern system, and are found in nearly every one of the thousands of cars now in service.

The limits of time compel me to content myself with the briefest possible reference to the most important development of electrical transportation which has yet come before the public—the electric underground railway. This undertaking having been placed in the hands of electrical engineers whose competency cannot be questioned, and backed by ample capital, has proved in London a phenomenal success. We are now assured that a syndicate of the most prominent capitalists of New York have undertaken to establish a system of transportation upon the same plan, consisting of a network of tunnels at a depth of 100 feet beneath the surface, and connecting all important points not only in the city itself, but in the adjacent sections of Long Island and New Jersey. In such a system it necessarily follows that the train must be run by electricity to the exclusion of any other power.

Every thoughtful person realizes that something must be done at once, not only to relieve the congestion of traffic which already exists in the streets of New York, but to provide for the enormous yearly increase which must be taken into the account. Statistics show that the traffic of the horse cars and elevated lines in New York has increased 46 per cent. within the five years from 1884 to 1889. A careful estimate which has recently been made of the movement of passengers in about New York during the year 1890, gives the following amazing results;

New York City (surface and elevated roads)	400 000,000
Brooklyn Bridge	38,000 000
Long Island ferries	00,000,000
Staten Island and New Jersey ferries	85,000 000
Total	603,000,000

If the profit derived from carrying these passengers amounts to only one cent each per trip, it nevertheless figures up to the snug little sum of $6,000,000 per annum, which makes a very comfortable dividend upon a capital of $100,000,000. Such a system would admit of the running of solid trains at very short intervals through the city, to and from all points in the suburbs, in every direction, and I venture here and now to predict that within the next twenty, if not the next ten years, electrical underground transportation will be brought to such a state of perfection that a passenger entering one of the central stations of New York may be deposited at his home station at any point within a radius of ten miles, in fifteen minutes' time, and at a fare of five cents. And this magnificent result is to be the contribution to the convenience and the prosperity of the public of the electrical engineer.

An exchange calls attention to a fact generally disregarded by the daily papers and the public at large: "In fatalities, it seems, gas is still ahead of electricity. In Massachusetts last year, three persons lost their lives by electric light plants, while eight perished from inhaling illuminating gas."

The Cincinnati Edison Electric Light company has purchased property occupying a space of 100 feet frontage on Eighth street between Elm and Plum streets, and will erect a power house upon the site purchased. The property begins just east of the Camera Club's building. The deeds were executed to Henry Villard, president of the Edison General company, as trustee, to be again transferred by him to the local Edison company when its organization is completed, which will be in a short time.

Commercial Rating of Electric Generators.

At the last meeting of the Chicago Electric club Thomas G. Grier read a paper on the "Commercial Rating of Electric Generators." The paper appeared in the last numbea of the WESTERN ELECTRICIAN. After the presentation of the paper the following discussion took place:

DISCUSSION.

ELMER A. SPERRY: To designate a 40-light machine in watts in specifications would, I think, not be strictly proper. Account should be taken of the fact that the resistance of long lines has to be overcome. For instance, the output of a 40-light dynamo supplying forty lamps on a short line woul. have to be different from that of a 40-light dynamo furnishing currents to forty lamps through a long line. The manufacturer is called to account for the failure of the dynamo. I think the arc machine should be made an exception and its output should not be designated in watts.

MR. GRIER: Referring to Mr. Sperry's remarks, I would say that if a machine was rated as 2,000 volts × 10 amperes this designation would clear him with the purchaser. By selling the machines with the output thus stated the full number of lights independent of a defective circuit, would only have to be provided.

C. F. DUNDERDALE: Rating a machine by the number of lamps it is to supply is apt to deceive the layman. The proper method is that in which the output is expressed in watts. The efficiency of the lamp is undoubtedly of prime importance. The expression "candle power," as now frequently used, means nothing.

C. G. ARMSTRONG: What we want is one standard and not a dozen. We should come to a basis upon which we can all stand. We have the watt by which we can rate the output of a dynamo. Our customers perhaps do not understand the meaning of this unit, and necessarily there will be some trouble in explaining it to them, but it is our duty to do so. If we do not take hold of this question nothing will be done. We must all pull together.

ALEXANDER DOW: Arc lamps of to-day do not vary much in their consumption of power. One maker's arc lamp for a 10 ampere circuit is much the same as regards the energy consumed, as the lamp of another maker. In fact, they are practically interchangeable. I had an experience about eighteen months ago, and had I listened to the paper just read before that time, I would not have had a two days' hunt for trouble in a certain machine. My company sold a dynamo and guaranteed it to pull sixty-three lamps on a 10-mile circuit, quite a heavy load on any machine although well within the capacity of the dynamo. The dynamo was tested in the factory and sent out on that guarantee viz: ten miles of No. 6 wire, sixty-three arc lamps. The machine was started, but for some time it was not loaded to its full capacity. It did its work without difficulty. The occasion came, however, owing to an increase in the city lighting, and it was worked right up to its guarantee. It refused to pull the lamps. The current fell off. The complaint came in: "Why did you sell this machine to pull these lamps, when it won't pull them?" It took me two days to get to the bottom of the trouble. I would not have wasted those two days had I had an idea of its output. When I came to the station the first thing I saw was a badly flaming lamp. Had I thought, as I should have done, I would have known that every other lamp was burning in the same condition. They were burning at about 48 to 53 volts and I did not find it out until the second day. I gave up in disgust, and I said the dynamo wouldn't do the work. I sent word to the factory, and they sent back word that I did not treat it right. I went back again, and then it occurred to me to ascertain the voltage of the lamps. I found that the lamps which were put in to burn at 48 volts were burning up to 52 and 53 and some of them up to 55 volts. Then the story of the bad adjustment came out. The superintendent said that he had adjusted every one of the lamps for a current of 9 2-3 amperes. As the lamps were of the differential type and were tested to burn silently at 9 1-3 amperes; when burning at 9 2-3 they would not work properly.

F. L. PERRY: There was a point that Mr. Sperry made while giving his reasons why a dynamo should be rated according to its output, in watts, as compared with an incandescent dynamo. His remarks relative to the circuit will be remembered. I would now like to ask if we have not to consider resistance of circuits from incandescent dynamos just the same as we have in the case of the arc machine? For instance, an incandescent system where we have very long feeders, and a great deal of drop in them. Why, therefore, can we not raise the same objection in the case of the incandescent machine?

ELMER A SPERRY: The subject of this paper is the commercial rating of dynamos. We propose to establish a unit, and we say that this dynamo is so many times that unit, and another dynamo is such a number of times that unit, giving another number. The question is strictly on the unit. I think that the unit to be adopted for the arc light system is distinctly and decidedly different from that to be adopted in the case of generators used for power, or for incandescent lighting. I will tell you why. Take the case already referred to The manufacturer is held strictly responsible, not only for the dynamo, but for the lamps, and as has been stated in this club during the last four months, the standard is such that one arc lamp of 2,000-candle power nominal, is equal to any other nominal 2,000-candle power lamp. That is, it takes, say, 10 amperes and 45 volts. Now then, inasmuch as the commercial rating of dynamos is strictly a commercial matter, why not use a commercial unit? Why not use some unit that the purchaser as well as the expert selling the plant, will understand. I contend that the arc light plant ought to be called a "ten lighter," or a "twenty-lighter," or a "thirty-lighter," as the purchaser supposes it to be; and I, for one, as a manufacturer, would be only too much pleased if the happy state of affairs could be brought about, so that we could sell a 10-light machine as a machine of so many watts, but I do not always believe in revolution. I believe in conforming to the demand made by the public, and bringing them around gradually. We will say, therefore, "Your machine, is a 40-lighter, but you must not use any more than so many ohms on your circuit." If the purchaser found out that the word ohm meant so many miles of circuit of such a number of wire, there would be nothing about specifications at all but that which ought to be easily adjudicated by one not an expert. Consequently, inasmuch as an arc lamp is known now to be a standard arc lamp, and takes a known quantity of energy, I do not see that if an arc light machine is rated at its capacity on a certain number of miles of No. 6 wire, the specification is not at once perfect, so far as the commercial side of it is concerned, and also so far as the scientific side of it is concerned, both requirements being, in my mind, perfectly filled.

F. L PERRY: Suppose you have a case similar to Mr. Dow's where the lamps are out of adjustment and are burning with a long arc. Where would you be in such a case?

ELMER A. SPERRY: The manufacturer is held responsible for that. Suppose Mr. Dow had said, "Your dynamo is all right." They would have sent the sheriff after him.

GEO. CUTTER: I think Mr. Sperry is with us. He first told us that it is not the right thing to do, and then he tells us as a manufacturer, he would like to see it; we must sugar-coat our pills so to speak, in order to bring it about. We must put the honest electrician and the honest dealer on a proper footing, and this is the only classification that enables us to do it. If I sell an arc light machine as a 40 light machine, all I have to do is to select my carbons with care and adjust my lamps to the lowest possible voltage that will give a good quiet arc possibly not a quiet one, and I will make a commercial 40-light machine carry 45, even 50. We all know this is so. Now, then, let us as an electrical club state that the proper way to sell a dynamo is by classifying it so that it can be tested, and so that every party bidding on the machine, is bidding for the same capacity of dynamo. It does not matter whether it is an incandescent machine or an arc machine. We understand well enough what a watt means, but the man out in the country does not understand what it means. Why? Because as we have said, we don't like to scare him. He understands well enough to day what an ampere means, better than some of us are willing to admit; therefore, it does not matter whether the dynamo is an incandescent or an arc machine, it should be measured by its watt output so that its capacity can be determined at any time.

In the case that Mr. Dow mentions it is easy to understand why he had to adjust sixty or seventy lamps in order to make the machine carry its load three or four months after the sale was made The parent company has to carry that expense, because the home company wanted to operate the plant with a cheap man. He had his arc lamps all carrying 48 or 50 volts when 45 was sufficient, and 45 was what it was sold for; this voltage gives a better light.

ELMER A. SPERRY: I still say that this question is strictly on the unit we adopt. We could adopt a watt or kilowatt. The kilowatt is I believe, another name for a group of watts. As I understand there is such a thing as a standard arc lamp, and to-day I find that the standard arc lamp is another name for a group of watts that is absolutely and commercially known. This group is known just as accurately as a kilowatt is. If we sell a dynamo to operate and maintain a certain number of lamps we still have a capacity in kilowatts just as much as though we used that name instead of arc lamps. If in addition we make that energy operate over a given circuit, if that given circuit is described, every requirement of the case is named. If the lamps are not standard lamps, however, then the specification is not covered; they must be standard lamps.

GEO. CUTTER: You have got to state what that standard lamp is.

ELMER A. SPERRY: Not at all. The standard lamp is known as much as the kilowatt is known, it being a group of a certain size.

GEO. CUTTER: State that your standard lamp is so many watts, and then you are all right; otherwise you have to assume it.

ELMER A. SPERRY: My ground is that the unit in the case of the arc light system, should be the arc lamp, rather than the mathematical term known as the kilowatt.

ALEX. DOW: We want a unit; it does not matter so much what our unit is, but do not want a unit that is like nine out of every ten lamps on the market. If I had to hunt for a similar trouble again and the system of watts was adopted, as suggested by Mr. Grier's paper, I would look to see where my watts were. As it was, I looked for the lamps. My lamp instead of being a unit was a great ways from a unit. The only unit which we can recognize is the watt.

G. A. E. KOHLER: My experience is limited to motors exclusively. If the facts Mr. Grier states about motors varying from 50 to 90 odd per cent is true, then I would like to know why, with about twenty different kinds of machines, of varying grades, in Chicago, the statements concerning every one of which will differ materially, there is not a necessity for some standard by which they may be represented to the customer? If presented in a light which he does not comprehend, I for one am perfectly willing to make him understand the standard.

C. H. WILMERDING: I think you have forgotten to look at this subject from the side of the central station man. He makes the contracts for central station work, and agrees, say, to furnish so many thousand candle power lamps. The city authorities may take it into their heads to use a photometer and they may find that the lamps do not come up to the guaranteed standard of candle power. The only safe way for a party in a position of that kind is to specify that he is going to furnish a lamp of so many watts, leaving the candle power out of the question altogether. If he is going to contract for an half arc lamp he will specify it is of so many watts, or a full arc lamp, of so many watts.

I do not think there will be much difficulty in educating the public to that method of judging the capacity of lamps. I have recently put in some incandescent lamps and one or two motors, with meters which read in watts. The customer pays so much per thousand watts. I have never had a bill questioned. They go down and look at their meter and they understand it just as well, if not better than they do the gas meter. I do not think the general public is very far behind the class of people that these particular customers represent. They understand the meters and pay their bills, and I think the rest of the public will be able to do the same.

ALEX KEMPT: If I understand Mr. Grier's paper, it recommends the adoption of the term "watts" in designating the capacity of dynamos. Now, I want to ask a few questions. Is there a dynamo, arc or incandescent, sold on this or any other market, whose capacity in watts is not known to the salesman? Cannot the salesman at any time answer that question? While the term is not used in trade, is it not known in every case, and does not every representative of an electro-dynamo manufacturer know its meaning?

W. J. BUCKLEY: If we all know what our machines produce in watts, then the watts should be taken as a unit. Besides, the watt is a unit that is not variable.

I think Mr. Sperry's remarks may be taken as an argument in favor of Mr. Grier's paper. Taking his arc machine, he calls it a ten light dynamo in his factory. It goes out and it has to send current through 18 miles of circuit, perhaps. That machine has to generate a current sufficient to supply practically 16 lamps; ten lamps in the circuit, and 6 lamps represented by the 18 miles of wire. The customer then, notwithstanding the fact that he has 18 miles of wire in circuit, still wants his ten lamps. Now, if the output was represented in watts, the customer would soon learn that a certain number of watts are consumed in the line, and the machine is generating the guaranteed capacity.

MR. GRIER: Mr. Kempt asked whether the agents do not know the capacity of their machines. I will say of the men that I met in competition not 50 per cent. knew anything about the capacity of the machines in watts. I find that when they are asked directly what the capacity of the machine is in watts they don't know.

ELMER A. SPERRY: I cannot remember seeing a machine delivered in the last eighteen months, or, say, eighteen years, but that somewhere on it the ampere or volt capacity of the machine had been stamped. On any of our motors so many volts and so many amperes, and generally the horse power, are stamped. The commercial rating is a rating that the purchaser and the salesman can go by. It is not what Sir William Thomson may call a machine—it is what in a commercial sense the purchaser and the salesman can go by and mutually understand each other as to what is being sold. Taking this ground, I agree entirely with Mr. Buckley. The question is not one of incandescent plants at all: It has been shown in the paper that every incandescent plant requires a different amount of current to produce the same candle power. But it seems to me that inasmuch as the technical rating is put on for technical purposes, and while it should tend to educate the public to the understanding of technical terms, yet I maintain that so far as practicable, those terms ought to be brought within the comprehension of the purchaser, and should be stated in ordinary terms that he can comprehend and understand.

MR. CUTTER: I do not think the question ought to be laid on the shelf. I think it is of considerable importance to us sellers of electrical machinery. We are selling something new. It is just as well for us to handle it, to classify it and sell it in such a way that the buyers will finally learn what it means. Now in point of fact very few people actually know what a horse power is, technically. Still in common practice they know what a horse power means. They do not try to think that a horse power is capable of doing the same amount of work as a horse. They do not bother their heads about that. But if a man wants to run a machine shop he knows that a three horse power engine will operate a certain amount of machinery. He has learned that a half dozen lathes, and a couple of planers can be operated with a certain number of horse power, and when he goes to buy an engine he tells how many horse power he wants. Now, it is the same with electricity. If we talk always of so many watts, so many amperes, constant current, etc, the customer will soon understand the terms He understands that 450 watts on a 10-ampere circuit ought to operate an arc lamp, or less than that if it is a half arc lamp as we classify them.

Those who are making specifications, and are called upon to adjust plants, or settle disputes are constantly meeting petty annoyances that would all be eliminated if it became the universal practice to classify generators by the watt output. We ought to take some action to push the thing forward as electricians, and to adopt that method of classifying our generators.

MR. STILES: It seems to me that both sides of this question come nearly together. I was very much pleased with the paper of Mr. Grier, and I believe that his statement that 50 per cent. of the people, or 35 per cent. of the people, who sell dynamos do not know their capacity in watts was true a short time ago. Electricians have been educated, and the people who are selling apparatus are becoming electricians. Now it strikes me that this thing is all right. You all say here that the people that are making machines ought to classify them by giving the watts. The persons who sell apparatus understand that, and of course if they propose to sell machines, they will give the purchaser what he wants. They are not going to spoil a sale of machines, as Mr. Sperry says, by insisting upon a man's knowledge about watts. A good many persons have found out that it costs money to educate purchasers The electricians are getting so they understand the matter, and after awhile the people will understand it, but if I were selling a machine I would give its capacity in just the shape the buyer wanted it. I would put in the word nominal, too, and be very particular in the specification.

American Institute of Electrical Engineers.

At the meeting of the American Institute of Electrical Engineers, January 20, the evening was devoted to the thorough discussion of Mr. Kennelly's paper on "Inductance and its Proposed Unit, the Henry," and the report of the committee appointed to consider the proper magnitude of the unit. The report of the committee was finally adopted, and is as follows:

At a meeting of the American Institute of Electrical Engineers, held September 16, 1890, a committee consisting of Dr. Wm. E Geyer, Dr. Louis Bell, George M. Phelps, Edward A. Colby, and Francis B. Crocker, chairman, was appointed to consider and report upon the best value for the "Henry"—the proposed practical unit of self-induction or inductance.

After careful consideration the committee has reached a conclusion and now recommends to the institute the retention of the present value of the practical unit which is 10^9 absolute units of inductance, usually expressed as a length equal to one earth's quadrant or 1,000,000,000 centimeters.

The committee finds that this value is too high in some cases for convenience, as many practical measurements of inductance would have to be expressed in fractions of a henry. At the same time other practical values would often amount to a number of henrys, and sometimes to hundreds or even thousands of henrys. It is of course impossible to have a unit fit all cases, and in this instance it happens that the average practical inductance would approximate one henry in value. This may be considered fortunate. Small values may be conveniently expressed in milli-henrys, analagous to milli-amperes, etc.

The committee is of the opinion that even if the value of this unit (10^9 absolute units) had been much less convenient than it is, nevertheless it would probably be very unwise to change it, for the reason that it is derived from and related to the other practical units in the ratio of one to one, just as one ampere is equal to one volt divided by one ohm. To depart from this plan, which has always been followed heretofore, would tend to destroy the harmony of the entire system of practical electrical units. The same fact made it necessary to define the farad as a capacity of one coulomb at one volt, although this makes its value so enormous that the micro-farad is always used in practical work. It appears, therefore, to the committee that the value of the "henry" should certainly be fixed at 10^9 absolute units of inductance.

At the regular monthly meeting of the council it was voted to change the date of the next meeting from February 17 to the 24th, in order to avoid a conflict of dates with the convention of the National Electric Light association, and also to afford members of the latter organization an opportunity of attending the institute meeting upon their return from Providence.

New York's Rapid Transit Projects.

The overcrowded condition of both the surface and elevated roads in New York city impresses every resident of the metropolis with the importance of devising some means to relieve the present condition of affairs. Much interest is therefore centered in the rapid transit commission's meetings. It is conceded that the elevated system is not equal to the emergency and there is a general demand to have the horse car lines removed. The only practical method would seem to be an underground system and that is only practical where electricity is employed.

At the last meeting of the commission Oliver W. Barnes presented the plans of the New York Underground Railway company which provide for a line partly under the street and partly under private property.

The New York City Railway company expressed a willingness to begin work immediately if the commission approved its plans. James C. Clarke, the engineer of the company, explained in detail his solution of the problem. It would be very easy, Mr. Clarke said, to provide a system of rapid transit for the city below Central Park, because two tracks would furnish ample facilities. But four tracks are necessary to furnish accommodations for the eleven miles of Manhattan Island, and it was that necessity which forced his company to resort to a route through the blocks. He believed there was only one remedy for such overcrowding as is seen at the Brooklyn Bridge and the City Hall station of the elevated road, and that remedy consisted in keeping incoming and outgoing passengers entirely separate. To do this stations 125 feet wide must be provided for a four-track road. He would construct the road in three tunnels. In the center he would run the express trains on two tracks. The local trains he would put in smaller tunnels, one on each side. Express train stations should be one mile apart, and he would arrange so that the passenger might make a part of his journey upon an express train and the remainder upon the local train if it would assist him in reaching his destination. The three tunnels would require a combined width of roadway of fifty feet. Local stations would require sixty feet. Combined local and express train stations would be 125 feet wide. It would be impossible to get accommodations for such stations under the streets. His theory was that the increase of value of property around stations would enable the corporation to obtain the rental of private property at a very low rate. He would construct the tunnels as near the surface as existing substructures would permit. He would use electricity as the motive power. He was the engineer of the West End Street Railway company of Boston, which has nearly 300 miles of electric road in operation, and it had been amply demonstrated that electric motors may be depended upon and that a speed of twenty five miles an hour is always available.

T. G. Gribble submitted a combined underground and surface system. "The substance of my scheme," he said, "is to unite a surface railway and an underground railway under one system and to operate them from one power station. They may be worked by cable or electricity, but the preference is given to electricity. The surface railway way train will be moving at from six to eight miles an hour The underground railway express train will be immediately under the street and moving at about thirty miles an hour, stopping at stations about one mile apart, upon the absolute block system."

William E. Maginn suggested a two-story elevated structure, the lower or local trains to be operated by steam and the upper express trains to be run by electricity. He had no route to propose.

J W. Reno, a mechanical engineer, advocated a two-story tunnel. The upper tunnel he would locate ten feet below the surface and use for local trains. The lower tunnel he would use for express trains, all to be operated by electricity. He did not suggest a route.

By far the most interesting plan thus far proposed is that laid before the board by Austin Corbin, representing the Metropolitan Underground Railway company, which proposes to construct the system in two and one-half years. The organization of this company is the first step in an effort to be made by the capitalists named to furnish the metropolitan district with what they believe to be the only adequate system of rapid internal transportation Not only is New York to be connected with Brooklyn but the two cities are to be connected with Jersey City, while the city of New York is to be tunneled on the east and the west from Battery Park to Jerome Park. It is a scheme that involves the boring of an underground passageway more than forty-two miles long, and large enough throughout its length to accommodate a two-track railroad of the usual surface road form and stability, not to mention the excavations necessary for terminals and stations, and the construction of elevators capable of handling train-loads of people every minute. It is a scheme that involves the expenditure of more than $60,000,000 in the actual construction of the permanent way and the purchase of an outfit.

It is agreed that electricity is the only motive power available for such an enormous project.

Chicago Electric Club.

The appointment of a committee to act for the Chicago Electric Club in all matters relating to the World's Fair will come before the board of managers of the club next Monday evening, February 2d. It was announced that the board would consider the matter January 10th, but the meeting was postponed.

CORRESPONDENCE.

New York Notes.

NEW YORK, Jan. 26.—This city has just been visited by a terrible storm which has simply paralyzed the electrial service of the city and cut it off almost entirely from the outside world. Telegraph, telephone and electric light and power wires are down in all directions and the city was in darkness last night. The storm began at eleven o'clock Saturday night and continued until noon yesterday. It was the severest of the season, six inches of snow falling. The snow clung to the overhead wires until it broke them and carried the poles down too. At daylight the work of destruction had commenced, and it continued until the snowfall ceased at noon, when the wrecks of trees and telegraph poles were to be found on every street, while irregular festoons of wires were hanging on every hand and detached lengths of wire were strung on every sidewalk. No such work of devastation has been known since the great blizzard of March, 1888, and it is a question if that memorable storm was more serious in its effects upon the telegraph poles and wires of the city. Early in the morning telegraphic and telephonic connections were broken, and, while the snow did not offer a bar to railroad traffic, the prostrate poles and fallen wires prevented the running of cars on many streets, and even the elevated railroad trains were compelled to move cautiously, and were often brought to a stop by the wires that had fallen across the track. As an illustration, one event may be referred to. At 7:30 o'clock in the morning a line of Western Union 80-foot poles fell with a crash, carrying not less than 150 single wires and two cables with from forty to seventy-five wires in them, to the ground. The police and fire departments were especial sufferers. All wire connections between police stations and the central office were broken and recourse was had to messengers. The fire department circuits were generally broken, and as no alarms could be sent out excepting on a few circuits patrols of firemen were established through the city. Men were set to repair damages at once, and these two most important of the city departments will soon have their telegraph service restored. The same may be said of the telegraph, telephone, and electric-light companies, all of which had their full effective force engaged all day. The Western Union is badly crippled by the storm, all wires being down but three, those being in the Western circuit conecting Albany, Rochester, Buffalo and Chicago. The work of repair will take several days. One thousand men will be sent out to-day on the lines outside the city. Mayor Grant has directed that the police throught the city see to it that the electric current be not turned on the various circuits until the Board of Electrical Control should certify that the wires are safe. The dangerous condition because of the wreckage was the cause of the order. The storm extended through New Jersey, Pennsylvania and Massachusetts. Reports from Jersey City say there is not an effective wire to be found, either telegraph, or telephone, fire alarm, or electric light. Save submarine cables to New York and Brooklyn the isolation is complete The same is true of Hoboken. Fallen poles and tangled wires cumber the streets in many places. Western Union wires are dead on the West Shore railway, and the only hope south is said to be by the New Jersey Central railway lines. All the poles on the vast Hackensack meadows are wrecked. The entire police and fire forces of Jersey City and Hoboken are on duty to quell any fire, there being no alarm service. At one point 100 telephone wires are down and meshed with ruined electric light wires. The city is dark, save for gas-lamps in a limited area never lighted by electricity. By much delayed trains come reports of the utter prostration of all means of communication in and from the outlying towns throughout New Jersey. A similar story comes from Boston where ninety telephone and telegraph poles are reported down.

There was no direct communication between Pittsburgh and points east of Harrisburg Sunday night. Two gangs of Western Union linemen left Pittsburgh early this morning to help repair the breaks between Harrisburg and Philadelphia.

Passengers from Philadelphia report that the storm was very severe there, great havoc being done to the telegraph and telephone wires, and telegraphic communication is practically suspended. The Western Union wires at Harrisburg are working westward but Philadelpnia, Reading and Washington are shut out, while Baltimore and New York are being reached by a long and circuitous route. The Postal has no communication at all. Sixty breaks have been found at a point a few miles outside of Harrisburg. It will take a month to repair all the telegraph wires in that city.

While the Rapid Transit commission is listening to suggestions of engineers and projectors of railroad schemes on the subject which is now uppermost in the minds of New Yorkers, the legislature is considering the bill reported by the Senate Railroad committee. There is no question before the people of this city to-day which awakens such lively interest as the rapid transit problem.

There were 105,358 shares represented at the annual meeting of the stockholders of the Edison General Electric company out of a total number of 118,613 shares. The following board of directors were elected: C. H. Coste, James B. Williams, Thomas A. Edison, J. —. Herrick, Samuel Insull, Edward H. Johnson, A. Marcus, Carl Schurz, Francis S. Smithers, Henry Villard, J. Wood Wright. At a special meeting held after the annual meeting the stockholders representing $10 500,000 out of $22,000,000 voted unanimously to ratify the action taken by the board of trustees in increasing the capital stock from $12,000 000 to $15 000,000. This stipulation, however, was agreed upon: that $1,000,000 should be kept in treasury of the company as a reserve fund.

Ezra I Gilliland has filed his answer to Edison's bill.

He denies that he was ever a confidential agent for Edison, or employed by him in any capacity. He says that he has been an inventor in electrical and other fields, and in 1884 was general superintendent of the mechanical department of the American Bell Telephone company in Boston. In that year Edison called on him in Boston, and induced him to resign his position and come to New York, and collaborate with him in matters of invention. At that time stock in the Edison Electric Light company was selling below par, and was paying no dividends: stocks in other companies formed by Edison were valueless and unsaleable; Edison himself was financially embarrassed, his laboratory at Menlo Park being closed, and his property there having been closed out by the sheriff. When he came to New York with Edison no partnership agreement was made, but they mutually agreed to share equitably in the profits of any inventions they might make. The only two inventions they produced that brought any profit were the railway telegraph and the phonograph, and these were suggested and in the main developed, so he claims, by Gilliland. At the defendant's instance the Edison Phonograph company was formed and its stock became valuable. Edison, he asserts, was satisfied with the $500,000 Lippincott paid him for his stock. The fact that Lippincott agreed to give him (Gilliland) $250,000 stock in the company he proposed forming, did not concern Edison. This stock was given in consideration of the

surrender by Gilliland of an agency contract he held from the Edison Phonograph company, without which the stock purchased by Lippincott from Edison would have been valueless for his purpose, and also in consideration of Gilliland's agreement to give his services as an inventor to the new company.

John C. Tomlinson, in his answer, denies that he was under general or special or annual retainer from the complainant, and says he he occupied, as to him, no general or even special relation of attorney or counsel. The remainder of his answer is mainly a corroboration of Gilliland as to the sale of Edison's stock to Lippincott.

It will be remembered that Edison claimed Gilliland and Tomlinson defrauded him of $250,000 in the phonograph deal.

There appears to be no end of trouble in store for the prosecuting attorney of this county due to Judge Lacombe's decision in Jugiro's case, and there is no consolation either in Judge Beach's decision in Slocum's case.

"In view of the decisions of Judge Beach and Judge Lacombe," District Attorney Nicoll announces "there is no likelihood that we shall have an execution by electricity in this state for at least a year. Meanwhile we shall go on doing our best to convict murderers, and, if the Tombs becomes too small to contain them, it will not be the fault of this office."

Warden Osborne is anxious to have the Tombs rid of the murderers now confined there. The law says that they must be taken to Sing Sing within ten days after sentence, and kept in solitary confinement until the day of execution But recently, in the case of James J. Slocum, Judge Beach of the Supreme Court held that solitary confinement is a part of punishment named in the sentence, and, as the convict cannot be made to undergo the punishment twice, he cannot be legally subjected to solitary confinement until the Court of Appeals having sustained the conviction, he is finally resentenced. So the murderers convicted since Judge Beach's decision stay in the Tombs pending the result of their appeal. Mr. Nicoll told Warden Osborne that he would try to have Judge Beach's decision reviewed by the general term, and if it was sustained to have a change made in the law. Mr. Nicoll also said that he had conferred with the attorney general of the state in regard to Judge Lacombe's decision in the Jugiro case, which practically gives counsel to a convicted murderer unlimited ability to appeal. Senators Evarts and Hiscock, Mr. Nicoll said, had been asked to urge the passage of a bill by congress to limit the right to appeal in criminal cases from orders of the judges of the United States courts.

At the meeting of the Board of Electrical Control, Friday, it was decided after the report of S. S. Wheeler, in which he recommended the trolley system for electric railways, to settle the matter of the application of the Harlem Bridge, Fordham and Morrisania for permission to construct a road with the trolley system. Mr. Hutchings and ex-Judge Ernest Hall argued for the company, while Arthur J. Butts, Charles Simpson and Louis Heintz, street commissioners of Morrisania, opposed the granting of the privilege. The mayor, after an examination of the system in Boston, Albany and other cities, had become convinced of its desirability, and said that he believed it was his duty to provide rapid transit for the people as soon as possible, and it was agreed to grant the privilege to the railway company.

The Franklin Electrical Society holds its meetings regularly on the second and fourth Friday evenings of each month at its rooms 239 East Fifty-seventh street, and its membership is increasing. The interest in electricity is rapidly extending, and the papers presented and discussed by this body of young men is a true indication of the trend of thought which prompts them to keep up with the progressive march of science.

At the meeting of the Gas commission, Friday, it was decided to have 108 new electric lights in the annexed district as follows: Third avenue, above Harlem Bridge, 47 lamps; One Hundred and Thirty-eighth street, to the Southern Boulevard, 16, Lincoln avenue to One Hundred and Thirty-seventh street, 5; Alexander avenue to One Hundred and Thirty-seventh street, 9: Willis avenue to One Hundred and Forty-eighth street, 14; Southern boulevard to One Hundred and Thirty-eighth street, 14; Harlem Bridge, 2; Madison avenue bridge, 1. W. H. T.

Minneapolis, Minn.

MINNEAPOLIS, Minn., Jan. 24.—State Senator McMillan of Minneapolis has introduced a bill in the legislature of Minnesota that is somewhat unique in its provisions, however laudable may be its purpose. The bill provides that when passengers in street cars are compelled to stand up they shall be exempt from the payment of fare. It adds, however, that if the passenger enters the car after having been notified by the conductor that the seats are all full, he must pay the usual fare. The conductor is required to display a placard on which the words "car full" are printed whenever that condition exists. Circumstances give this seemingly innocent and unimportant bill a peculiar interest. Nearly all the street railway lines of importance in the State of Minnesota which would come within the scope of the proposed law are owned, practically, by one corporation; namely, those of Minneapolis, St. Paul and Duluth. This corporation has undertaken the task of constructing and equipping several hundred miles of electrical railway within one year of the time of starting, and has so far progressed with the work that at this time about four-fifths of the proposed lines are completed, and in successful operation. The carrying capacity of these lines is just about the same that it was when the horses were the motive power, but travel has so greatly increased that the accommodations are admittedly deficient. The street railway company is making every effort to remedy the evil, but requires time. The bill is intended to accomplish what will undoubtedly be accomplished without its agency within a very short time, and is rather a child of individual impatience than of public necessity. State legislation is certainly not required and should not be asked when the municipalities most concerned are entirely satisfied with the progress made by this company in the extensive work it has undertaken.

The street railway companies of the Twin Cities have glutted the local horse market, notwithstanding their effort to avoid this condition. Thousands of these animals are on sale and at the periodical auction they are sold at prices ranging from $18 to $75. Farmers are the principal purchasers.

The Northern Car company of this city, builders of electrical cars, elected the following officers at their annual meeting. recently held: C. P. Jones, president and treasurer; A. B. Robbins, vice-president, and George P. Stearns, secretary; directors, A. H. Robbins, H. A. Town, W. S. Nott, C. P. Jones, W. B. Manier, George P. Stearns of Minneapolis, and C. E. Mabie of Sioux City. New buildings have been added recently and $30,000 expended in machinery. The company has some large contracts on hand for motor cars, among them being one for the Fidalgo City & Anacortes railway and another for the Tacoma, Wash., line. The Robinson & Moan Car company, which preceded it in business, has satisfactorily adjusted its financial difficulties and will pay its creditors in full. The Northern company has no connection whatever with the Robinson & Moan company.

The cable line of the St. Paul company continues to be prolific in law suits, and nobody knows better than the company itself that it ought to be electric. In the District Court at St. Paul a suit has been brought by David Newhart to recover $5,975 personal damages from the company, for injuries the plaintiff claims to have sustained while a conductor on a car. He tried to apply the brake, but it was defective and broke, striking him so violently that hemorrhage set in and he was permanently injured.

Another fatality has occurred on the interurban line. Andrew Hansgen, a boy sixteen years of age, sprang from a car on which he was supposed to have been stealing a ride and fell beneath the wheels of the motor passing on the other track. He was instantly killed.

All is quiet among the telegraph operators in the Twin Cities. If any strike was contemplated it was declared off before events came to a focus, and work has continued uninterruptedly at all the local offices, including the Milwaukee.

The electric light plant in the St. Paul high school building, which was made the subject of an interesting controversy among the electrical companies of that city recently, is now undergoing thorough examination by local experts. It will probably be accepted and the contractor paid in full.

An answer has been filed by the Minneapolis Street Railway in the injunction case of John G. Gluck. The company was temporarily restrained by the institution of this suit from building its projected electric line on the Hennepin boulevard. In the answer the company claims that the park board has full control of the city parkways and had authority to grant it the right of way desired on the Hennepin boulevard. It denied that a majority of the property owners are opposed to the line and says that the only change the company will make in the appearance of the street will be the erection of poles for trolley wires. The case is now on in earnest, and will be fought vigorously by both sides. The merits of the case seem to be with the street railway company.

Thomas Lowry, president of the Twin City Street Railway companies, has just succeeded in negotiating $9,000,000 of the bonds of that corporation, thus making it possible to continue the great extension and improvements in the system projected for this year without delay, and to finish the electrical equipment as fast as it may be needed. Local financiers regard Mr. Lowry's success in this transaction as little less than remarkable, considering the present financial situation, and the public at large receives the intelligence with the utmost gratification. It is regarded as insuring the complete elaboration of all Mr. Lowry's plans, which are known to involve the construction of many important new lines connecting suburban points with the cities. During the past few days much entertaining gossip has been in circulation about the street railway corporation, the principal item of which is that J. J. Hill, president of the Great Northern, and Sir Donald Smith, the well known Montreal financier, have bought large blocks of its stock. The Great Northern is the principal competitor of the inter-urban line for travel between the cities which fact gives this transaction more significance than it appears to have on the surface. One of its results will probably be the discontinuance of many Great Northern trains now running regularly between the cities, with the purpose of concentrating the travel on the inter-urban line now in operation and others to be constructed. It is a graceful way for Mr, Hill to get out of his difficulty, in view of the fact that the steam lines will be unable to compete with the electrical lines for this business as soon as the latter are equipped as it is intended they shall be.

The city council of Hallock, Minn., has granted an electric lighting franchise to the Thomson-Houston company, and an arc and incandescent plant will be established at once. Hallock is a small town in the northern part of the state. N. O. F.

Pittsburg, Pa.

PITTSBURG, Jan. 24.—The city authorities of Pittsburg are seriously contemplating the idea of introducing electric street sweepers for the purpose of carting away the dirt from the city streets. The scheme is as yet somewhat embryonic, but this is the way in which the sweeping is to be done: The sweepers will be made very much like an ordinary traction engine, but electricity will be used as the motive power. This electric current is to be obtained from the wires belonging to the street car companies. Current will be brought down by means of a trolley pole with an elbow, instead of the ordinary straight bar now used, where the cars run directly under the wires. The pole can be so balanced as to easily hold the trolley in place on the wires. The distance from these wires to the curb is not so great, in any case, as to prevent this method of introducing the current into the motors from being practicable. The arrangement for guiding the machine will be much the same as used in the traction engines, and will consist of chains which wrap around a movable front axle, and will be operated like an ordinary brake wheel. This will only collect the dust, and it will then be carted away in the usual manner. As it is the idea of the city fathers to tax the street car companies, it is thought that this will be a good way of obtaining the revenue.

The Uniontown Electric Street Railway company is waging just now a great war with the Southwest Railway company. It appears that the former company in laying the tracks for its lines must cross the tracks of the latter. To this proceeding the Southwest company has strenuously objected and several days ago, when the employes of the electric street railway company were engaged in laying rails across the tracks of the steam railway company, a number of trainmen attacked them. The electric street railroad company also found out the other day that the wires which crossed the railroad were cut, and an investigation has been made since, which lays the blame of cutting the wires at the door of the railroad company. One of the employes of the railway company has been arrested for malicious mischief and the company has sued the Southwest Railway company for damages on the ground that its charter gives it the right to cross the railroad tracks. The outcome of this litigation is anxiously looked forward to by the residents of Uniontown, because they are very anxious to see the electric street railway in operation.

The Chartiers Valley Electric Light & Power company is about to commence the operation of an electric lighting plant which will furnish electrical illumination for the boroughs of Mansfield and Chartiers, both situated near Pittsburg. The company was organized a short time ago by a number of Pittsburg and Mansfield capitalists. The Westinghouse system of alternating current incandescent lighting has been adopted and S. A. Duncan, who was formerly with the Allegheny Light company of Pittsburg, has accepted the management of the new company.

The first electric snow sweeper arrived here yesterday. The sweeper belongs to the Duquesne Traction company and it is manufactured by the Thomson-Houston Electric company of Boston.

The government has just completed the installation of a 400-light, 100-candle power incandescent plant in the federal building which is being erected in this city. The

building has been in the course of erection for many years and it is now almost completed. Nothing but inside work remains to be done. The incandescent lamps were put up in order to give the workmen light during their employment. E. H. H.

Des Moines, Ia.

DES MOINES, Ia., Jan. 20.—The citizens of Keokuk had anticipated the completion of their electric street railway by the first of the present year, but owing to a lack of funds the work of construction was stopped some time ago. By a change in the company made last week, by which George, William J. and Henry C. Reiner of that city secure a controlling interest in the stock, the early completion of the system is assured. A small portion of the line has been in operation for some time, and has proven quite successful in a financial way. A number of finely finished vestibule cars have been purchased by the new company, and the entire system will be in operation within a very short time.

The Des Moines Electric Street Railway company will greatly enlarge its system during the coming summer, and will soon begin the work of changing the Belt motor line, running north to Highland Park and vicinity, into a well-equipped electric line. The distance is about four miles. The new line will be equipped with new and elegant cars of either the St. Louis or Pullman make, and furnished with Westinghouse motors. The completion of this change will make Des Moines' car system entirely electrical with the single exception of a short horse car line to the south city.

Cedar Rapids is the only one of the important cities of the state that still clings to the old horse car system, and the city council is now considering a proposition from the owners of the franchise to change the motive power to electricity. There is little doubt that the change will be made during the coming summer. The change contemplates the operation of electric cars between Cedar Rapids and Marion, a distance of four miles, now covered by the horse car system, and the building of a complete and extensive system within the city. The stockholders of the company are all Cedar Rapids capitalists, and if the desired permission is granted the work will be pushed rapidly to a completion of the change to rapid transit. F. M. C

Kansas City, Mo.

KANSAS CITY, Mo., Jan. 20.—A building permit has been issued to Seth Ward and S. K. Thatcher for changes to be made in the Western Union Telegraph office. The Western Union officials visited the city recently and found the headquarters here crowded. The roof of the building will be raised about four feet, the whole of the second floor converted into one room, and the partition taken out between the two rooms on the ground floor. This will give the company the whole of the two buildings, and will make commodious quarters.

Directors were elected this week by the Pacific Mutual Telegraph company. Among them were: A. B. Chandler, D. Townsend, L. D Parker, J A. Corby, E. C Platt

The Kansas City Electric Light company has elected the following board of directors: W. B. Grimes, J. S. Chick, J. H. North, F. K. Hoover, W. B. Grimes, Jr., James Scammon, E. R. Weeks, F. N. Chick and O. H. Dean.

The Edison Electric Light company has elected the following directors: W. B. Grimes, J S. Chick, J. H. North, F. K. Hoover, W. B. Grimes, Jr., W. P. Hix, E. R. Weeks, F. N. Chick and O. H. Dean.

The southern extension of the "L" road is completed and Colonel Edgerton and Judge Hoag assert that the road will soon be in operation. The delay has been due to difficulty in getting the machinery into position. The company has placed two large Westinghouse engines for operating the dynamos in the power house at the west end of the tunnel. This company is not connected with the "L" road system.

The building of this line means that an hour or more consumed heretofore in going from one side of the city to the other is to be cut down to fifteen minutes. P.

Cleveland, O.

CLEVELAND, Jan. 24.—The Johnsons intend to build an electric line at Ulrichville, O., and also supply lights.

The Edison Electric Light company in Cincinnati will erect a power house on Eighth street, between Elm and Plum streets.

The Consolidated company of Cincinnati has made arrangements to run every alternate car on the Walnut Hills cable line by electricity, inasmuch as some of the patrons prefer the motors.

Additional motors are to be put on the electric railway at Salem, O.

The Cincinnati Electric Light company secured the city contract to light West Eighth street from McLean to Glenway avenue, at the rate of $12 per month for all-night service.

The Cincinnati Electric Gas Lighting company has asked the court to dissolve the company because it failed in its object.

The Cowles Electric Smelting and Aluminum company at its meeting Jan. 21, decided to reduce the price of pure aluminum to $1.25 a pound, which is the lowest price thus far attained. The company predicts that the pure metal will undersell copper in the near future.

The Cleveland Aluminum company will shortly issue a pamphlet treating exhaustively of pure aluminum and its alloys. R.

THE ELECTRIC LIGHT.

The Little Falls, Minn., Electric Light, Heat & Power company, which was formed about two years ago and incorporated with a capital stock of $50,000, is now operating an arc and incandescent plant. The Westinghouse alternating and the Waterhouse arc systems are used. At present twenty two arc lights and 700 incandescent lamps are in use.

While enumerating some of the principal institutions of San Diego, Cal., the *San Diego Union* has this to say of the electric light system of the city: "The incandescent system of electric lighting was introduced about two years ago by the Electric Rapid Transit Street Car company, George D. Copeland, president, and has become an assured success under his management, reducing the rates of commercial and domestic lighting beyond any which ever before prevailed in this city. In fact the rates for gas and electric lights are now lower in San Diego than those prevailing in other towns on the Pacific coast, where steam power is used, and should the project to use the water power at the end of the flume materialize, still further reduction in rates may be expected." The present Copeland plant consists of two Westinghouse alternating current incandescent dynamos of a capacity of 750 16-candle power lamps each, including exciters, switch-boards and electrical instruments. The dynamos are run by steam power, and so complete are all the operations of the system that there has been no interruption in the regular business of light distribution during the past year. This plant was established at the close of the "boom" period, and many predicted that the effort to establish the business in the face of the opposition of the old established and wealthy gas company, and during a time of such financial depression as has prevailed during the past two years, would be a failure. Under the economical management, however, of Mr. Copeland, the enterprise has become one of the permanent and successful institutions of the city.

Electricity has been utilized to such an extent in securing brilliant effects in theatrical work that it is not surprising that it is being used in club entertainments. One of the most interesting displays of this kind was given last week at Evanston, Ill., one of Chicago's suburbs. The Country club of that town has been giving a series of entertainments and dancing parties and the change from the regular programme was thoroughly appreciated. The walls of the large room in which the entertainment was given, were draped with Indian blankets; a bear climbing an oak tree and other attractive features gave the scene a weird aspect. When the sheeted and masked company marched in ghostly procession to this room, where the candles they carried were taken from them, the electric lights were suddenly turned out, leaving them in the company of an uncanny gibbous moon which shone down on an owl and the ambitious bear. In the pale light two figures were visible, one clad in black and the other in white—the spirits of light and darkness; they engaged in sword combat, and at each contact of their weapons a blaze of electric sparks flew from the steel; the moon went out, and the rear of the room was illuminated by pale electric flashes in fantastic shapes. The spirit of light prevailed and downed his dark-dominoed adversary, and immediately the whole end of the room was illuminated by a brilliant electrical display. On the left the word 'Light" stood out in fiery letters, and on the right a kaleidoscopic star two or three feet in diameter reflected a hundred-fold the revolving lights before it. Between, as a background, were Geissler tubes of all tints and shapes, and above all were the large letters in light, "C. C.," surmounted by a big stuffed eagle. The display was pronounced the most brilliant and novel entertainment ever given by the club and the members highly complimented Dr. G. W. Whitefield who had charge of the arrangements.

THE ELECTRIC MOTOR.

The city council of Independence, Iowa, last week granted a franchise for an electrical street railway in that city to be constructed and operated by a corporation consisting of C. W. Williams and others. The line as projected will run from the Illinois Central depot through the city to the Burlington line, thence through Rush Park to the Iowa State hospital for the insane. They intend to have it in operation by the first of June.

The popularity of the electric railway is shown in the report of the company operating the line between Rochester, N. Y., and Ontario Beach, a summer resort on Lake Ontario, just north of the city. During the year 470,000 passengers were carried over the line, and cars on the road traveled an aggregate distance of 197,342 miles. The Ontario Beach cars now run direct from the center of the city to the lake shore without change. The Thomson-Houston system is used on this line.

The railway department at the Chicago office of the Thomson-Houston Electric company reports the sale of an increased equipment to the Union Depot Street Railway company at St. Louis, Mo,, consisting of sixteen 30-horse power double motor trucks and eight 80-horse power generators. The power station of the Union Depot Railroad company at St. Louis, is perhaps the largest one in the United States, with the exceptions possibly of that of the West End Street Railway company at Boston, Mass. The Union Depot power station is equipped with two 500-horse power, one 300-horse power and one 150 horse power Corliss engines, and twenty-six 80-horse power generators, of the Thomson-Houston manufacture. From this station are operated the Union Depot Railroad system, the Mound City lines, and one or two additional lines will also be operated from this same plant. The Western office also reports the sale of a 28-car equipment to the street railway company at Little Rock, Ark. Arrangements have been perfected by which this will be one of the finest and most completely equipped electric street railway plants in the United States. A handsome brick power station will be constructed and equipped with the best Corliss type of engines that can be had The Thomson-Houston company intends to make this plant a model one in every respect. The Thomson-Houston company also report the sale of an extensive electric railway equipment to the street railway company at Marquette, Mich., and likewise small increases to several other street railway companies in the West.

The annual meeting of the stockholders of the Rochester, N. Y., Railway company was held last week. The financial statement and a detailed report of the work of construction was presented, and received by the stockholders with satisfaction. It is the intention of the company to continue extending the electric system until all the lines of the city are equipped. Additional machinery to be used on the lines is constantly arriving. It is expected that the Lyell avenue line will be equipped with electric cars by February 1. The cars for this line are now stored in the motor house ready for use. They are of a much lighter color than the cars now in operation, and somewhat resemble those of the North and West avenue line. The Monroe avenue line will be the next to have electric cars after the Lyell avenue line. The election of directors and officers resulted as follows: Directors, H. Sellers McKee, Pittsburg; M. A. Verner, Buffalo; E. E Denniston, Richard M. Clay, Horace Magee, T. De Witt Cuyler, Philadelphia; Benjamin Graham, New York; A. G. Yates, Frederick Cook, W. S. Kimball, A Luetchford, M. H. Briggs, J. N. Beckley, Rochester; president, John N. Beckley; vice-president, Benj, Graham; secretary and treasurer, Arthur Leutchford; general manager, C. K. Minary. The newly elected president has been engaged in street railway work only a short time, yet he has won an enviable reputation among street railway magnates. He is a lawyer by profession, and has been twice honored by his fellow citizens with the office of city attorney. He made a most capable official. Since that time he has been a member of the firm of Bacon, Briggs & Beckley, one of the leading law firms of the state. Mr. Beckley was the prime mover in the organization of the present company, and negotiated the purchase of the road from the old company. He is thoroughly imbued with the possibilities of the electric motor in street railway work, and is interested in several other companies operating roads by electricity, notably in Buffalo, N. Y., and Bridgeport, Conn.

THE TELEGRAPH.

A New York correspondent writes: The latest advices received in this city of the condition of affairs in Chili indicate that the revolution there has become a very serious affair. The Anglo-American Telegraph company announces that telegraph communication between New York and Chili by way of London, Lisbon and Buenos Ayres is so uncertain that messages are accepted by the London telegraph authorities entirely at the risk of the senders. The delivery of all messages rests with the Chilian government, and the officials of the Balmaceda Government as already stated in the London cable dispatches, are assuming a censorship of the telegraph companies to such an extent as to send out news which is subsequently contradicted by private mail advices, so that the telegraph cannot be altogether relied upon in either direction.

Miscellaneous Notes.

Prof. Francis B. Crocker's address on "Electrical Units of the Present and Future," which was delivered before the New York Electric club, December 18, has been published in pamphlet form.

The Chicago Electric Protective company has just been incorporated to deal in electrical goods; capital stock, $100,000; incorporators, Mark Simons, Walter M. Lowry and Frank Weighley.

"Pocket Handbook No. XI," has just been issued by the Standard Underground Cable company of Pittsburg. Those who have examined this little book in previous years know what a valuable work of reference it is. The information which it contains was compiled by J. W. Marsh, secretary and general manager of the company. It will be found of no little value to those who have aught to do with wires for electric work. The book is handsomely made up, and those who receive a copy should deem themselves fortunate.

Prof. W. S. Johnson made an address before the Wisconsin Electric Club, Milwaukee, last week on the subject of heat regulation. The history of the art was briefly touched upon. The noted French electrician, Dumoncel, was given the credit of having invented the first electrical device for controlling temperature. The modern device was explained. Heat is practically regulated by a thermometer located in a room; the thermometer, by the means

of electric connections and devices, operating a small pneumatic valve. The air, which is controlled by the pneumatic valve being under pressure, operates valves or dampers on the heating device. After the lecture the members of the club were invited to the engine room of the Loan & Trust building, where the air compressor, and other automatic parts of the apparatus are situated Every part of the heat regulation of the entire building was shown to be automatic. An interesting part of the exhibition was the testing of the alarm device by which the engineer is notified of any error in the working of the system. One of the members of the club went into one of the rooms and tampered with the thermostat. Instantly a loud alarm was sounded, and the engineer at once located the meddlesome intruder.

Personal Mention.

Charles G. Armstrong, Chicago, has been engaged by Adler & Sullivan, architects, as consulting-electrician. This is not only a compliment to Mr Armstrong, but it tends to show that the important part which electricity is playing in everyday affairs is becoming generally recognized.

Business Mention.

James H. Mason of 118 and 120 Park avenue, Brooklyn, N. Y., has just issued a catalogue describing his primary battery system.

The Electrical Supply company has two Universal arc lamps burning on a 110 volt circuit in its store at No. 171 Randolph street, Chicago. The regulation is very effective as the arc seems perfectly stationary. The absence of hissing and flickering is noticeable. The lamps are said to be good "salesmen."

The Star Electrix company of Philadelphia continues to add new things every few weeks and already have quite a complete line of electric lighting supplies, such as 5 ampere and 10 ampere single pole switches, 25 ampere double pole switches, key and keyless sockets, insulating joints, gas attachments, ceiling cut outs and branch and main cut-outs, etc.

The William D. Gibson company, 65 North Jefferson street, Chicago, are having a good demand for the various springs which they make as specialties, and are running their immense factory to its full capacity. They make any spring needed in all forms of electric machinery, and by a special system of tempering, turn out a very high grade class of goods.

The Sunbeam Incandescent Lamp company, Chicago, recently settled in new and larger quarters than those heretofore occupied, where with specially designed apparatus and the best modern equipment, it is prepared to take care of the trade. Since the first of last June the company has been unable to fill all the orders. The company is located at 805 Chamber of Commerce building.

A new catalogue has just been issued by the Edison Manufacturing company of Orange, N. J., describing the Edison-Lalande battery. The pamphlet is a handsome one and is thoroughly illustrated. It contains a number of fac-simile letters from persons who have tested the battery and found that in practice it is as efficient as its makers claim. The catalogue is one of unusual interest to those who use primary batteries.

An exceedingly handsome catalogue has just been issued by Stanley & Hall of 32 and 34 Frankfort street, New York. It describes at considerable length the electrical house furnishings and general electrical supplies sold by the firm The pamphlet is profusely illustrated, and will be found of no little interest to those contemplating the purchase of electrical apparatus. The catalogue is thoroughly indexed so that it may be readily consulted by those who are examining electrical supplies.

The Illinois Electrical Material company are having an excellent trade at even this season of the year and are making extensive improvements for the coming year. Tha Star Electrix specialties for which this company hold the general Western agency, are becoming very popular. A fine catalogue is being prepared, to include a large list of electric light and electric street railway specialties, which will be ready for distribution at an early day. Altogether, the outlook for business is exceedingly bright.

The Commercial Electric company of Detroit has secured the agency for Michigan and the northern half of Indiana for the Sperry arc apparatus and the National Electric Manufacturing company's transformer system. Several fine contracts have already been received, including a 30 arc and 500 incandescent plant at East Tawas, Mich., and a 200 arc plant in a magnificent new building now nearly completed in Detroit for J. L. Hudson, to be used as a clothing store. Mr. Fisher and his associates are energetic, wide awake business men, and the interests of these already popular systems will not suffer in their hands.

The International Okonite company (limited), New York and London, has declared a dividend for the six months ended December 31st, 1890, on the capital stock of the company at the rate of 8 per cent. on the preferred, and 10 on the ordinary shares. As stated in these columns last July, this company is the consolidation of the Okonite company of America, and Shaw & Connelly of England, both prominent manufacturers of insulated wires and cables for electrical purposes. This liberal dividend shows an immense business done by the International Okonite company during the first six months of its existence, and while much of this has undoubtedly been acquired in America, the business done abroad has been considerable. The manufactory at Newton Heath, Manchester, is rapidly nearing completion and the necessary machinery is nearly all ready for delivery. When this addition to the existing works comes to be fully developed, a noticeable increase in the English business is looked for. The company handles okonite insulated wires and cables for aerial, undert ground and submarine electrical purposes, also Candee and Manson wires. These goods will be vigorously pushed abroad, where their popularity is nearly if not quite as great as in this country.

The Michigan Electric company has just been organized in Detroit, with a paid up capital of $25,000. The following officers have been elected: F. F. Humphrey, president; W. McKee, vice-president, and superintendent; H. H. Humphrey, secretary and treasurer, and manager; R Scott Campbell electrician. A new building 125 feet deep and three stories in height is being fitted up with the latest improved machinery, and when ready the manufacture of a general line of electrical supplies is to be commenced. The agency for a number of specialties has been secured, and it is the intention of the managers to bring out a new motor which is nearly completed, and which is claimed to have a high efficiency.

J. F. Shawhan of the Shawhan Machine Works, Detroit, has recently completed the fitting up of a shop for general repairs and for the manufacture of a line of excellent electrical apparatus. Every piece of machinery is of the latest and most improved pattern and with Mr. Shawhan's well-known skill as a mechanic, satisfactory results may be expected. In addition to the usual equipment found in establishments of this class Mr. Shawhan has supplied himself with the most complete machinery for gear cutting and is prepared to do this work under his own supervision. Taken as a whole the work shop is a model of its kind and there can be no doubt as to the success of the undertaking.

English, Morse & Co. of Kansas City, Mo., last week shipped to Garnett, Kan., a 60-horse power Ide engine. It will be used in a combined electric light and waterworks station, which the city has contracted for. The firm also shipped an additional 50-horse power steel boiler to the Butte City Gas Light company, Montana. The firm has Swift & Co.'s contract for a compound duplex pumping engine of 1,000 gallons' capacity per minute. The Lahman & Kirkwood shaking and dumping grates, American leather link belt, Hill clutch pulleys and couplings, the firm reports, are very popular with operators of electric light and railway stations, and trade in engineering specialties generally is quite good.

The Electrical Supply company of Chicago has this very strong indorsement of Habirshaw wires from Walker & Kepler, Philadelphia: "We have been using your white core wire almost exclusively during the last year for our incandescent work. In this time we have wired the Drexel Building, 2,600 lights; Keystone Bank, 400 lights; Catholic High School, 600 lights, and a large number of other buildings; total number of lights probably 10,000 to 12 000, and we are pleased to say that we have never had the least trouble with the insulation, which we consider A 1. We might add that the local Edison company in this city have had their inspectors examining and testing the work done, and they say that the Habirshaw insulation shows up first-class and above all others."

The following communication has been sent to the WESTERN ELECTRICIAN: There seems to be a prospect that the well-known Ball engine, many of which are doing such good service everywhere, will shortly be manufactured by a new company organized for that purpose in the vicinity of New York. We understand that a number of New York gentlemen have made arrangements with F. H Ball of Erie, Pa, the inventor of the engine, and have bought his patents. Mr. Ball will sever his connection with the Ball Engine company of Erie, and shortly take up his residence in the East. It is expected that the new company will be incorporated with ample capital, and that shops will be erected possessing all recent mechanical improvements. The Ball Engine company of Erie will continue, as at present, to manufacture the engine under Mr. Ball's shop rights, and with James McBrier as president, whose large lumber and other interests in the West have made his name familiar to business men in that section. The relations between the Erie and New York companies will be very cordial and intimate, since the latter will be largely interested in the stock of the former. Prominently associated with Mr. Ball will be Mr. Thomas C. Wood, who for many years has been connected with the engine interests both in Erie, Pa, and in New York. The new enterprise is the result of the increase in demand for the Ball engine, Mr. Ball's system of governing having proved so successful, and the Ball engine so reliable, especially for the electric light and street railway interests, that it is safe to assure for the new company a large and profitable business from the start.

Electrical Patents.

Issued January 20, 1891.

444,807. Combined Electric Motor and Lamp Socket. Ralph H. Beach, St. Paul, Minn.

444,816. Railway Signal. Nathaniel B. Cregier, Chicago, Ill.

The prime object of the invention is a train signaling system by which a signal sent from one car of the train to the engine or from the engine will be automatically repeated in every car of the train.

444,825. Electric Gate. Harleigh Gillette, Highland Park, Ill.

444,858. Portable Electric Welding Apparatus. Elias Ries, Baltimore, Md.

444,871. Snow Sweeper. Isaac F. Baker, Lynn, and Robert Booth, Malden, Mass.

444,872. Snow Broom. Isaac F. Baker, Lynn, and Robert Booth, Malden, Mass.

444,879. Insulator. Charles Elkins, Saccarappa, Mo.

444,881. Electrical Exercising Machine. Joseph E. Gardiner, Nyack, N. Y.

444,892. Combined Cut-Out and Lightning Arrester. Albert T. Aldrich, Worcester, Mass.

444,893. Trolley for Electric Railways. Harry H. Blades, Detroit, Mich.

444,896. Automatic Electric Igniting Device. Thomas W. Lane, Boston, Mass.

444,900. Regulating Apparatus for Electric Motors. Merle J. Wightman, Scranton, Pa

The invention consists in a switch by which a single operating lever is used to make all the necessary connections for coupling the motors in various ways and for regulating them when so coupled.

444,914. Electric Blank Heater for Forging Machines. George D Burton, Boston, and Edwin E. Angell, Somerville, Mass.

444,922. Mounting for Electric Car Motors. Edwin W. Rice, Jr., Lynn, Mass.

444,925 Electric Arc Lamp. Elihu Thomson, Lynn, Mass.

The invention relates to mechanism for regulating the separating and feed movements of electrodes in electric arc lamps fed from a circuit having a constant or nearly constant current.

444,926. Method of Electric Welding. Elihu Thomson, Lynn, Mass.

444,927. Method of Electric Welding. Elihu Thomson, Lynn, Mass.

444,928. Method of Electric Welding. Elihu Thomson, Swampscott, Mass.

The invention relates to a process of electric welding in which the surfaces to be welded are pressed together to form a union, and the heating of the surfaces to the desired plasticity is effected by means of an electric current passed across the joint or line of proposed union.

444,924 Incandescent Electric Lamp. Elihu Thomson, Swampscott, Mass.

444,930 System of Distributing and Metering Electric Energy. Elihu Thomson, Swampscott, Mass.

444,931. Electric Meter. Elihu Thomson, Swampscott, Mass.

444,934 Alternating Current Motor. Carl O. C. Billberg and Paul A. N. Winand, Philadelphia, Pa.

The motor embodies some of the principles of an alternating current transformer; but one of the main features of the invention is the construction of the motor with an armature in the form of a laminated Faraday disk or disks or cylinder or cylinders connected up in a circuit and rotating with a magnetic field whose polarity follows or accords with the alternations of the current supplied.

444,939. Alternating Current Dynamo. Hermann Lemp aed Louis M Schmidt, Lynn, Mass.

The special object of this invention is to produce a compound alternating current dynamo in which the field excitation shall be obtained wholly from a single field exciting circuit or coil traversed only by current derived from the armature coil or armature which supplies the work.

444,946. Method of Electric Welding. Elihu Thomson, Lynn, Mass.

444,966. Electric Indicator. Charles Wirt, Orange, N. J.

444,969. Electrode for Secondary Batteries. Foree Bain, Chicago, Ill.

444,977. Electric Arc Lamp. William H. Elkins, Hornellsville, N. Y.

The claim reads as follows:

"In combination, a spring switch with two blocks, a shunt magnet controlling the movable member of the spring switch, two lamps, conductors connecting the like poles of the lamps to one of the main terminals, other conductors connecting the other poles of the lamps to the switch blocks of the spring switch, and a shunt circuit of which the coil of the switch controlling magnet forms a part, and with one of its terminals connected to one of the switch blocks."

445,008. Insulator. William Vogler. Somerville, Mass.

445,023. Independent Electric Clock. Edward Lefebvre, Montreal, Canada.

445,051. Electric Motor Truck. Royal P. Faries, Wichita, Kan.

445,073. Clock-Winding Mechanism. W. N. Packer and W. W. Bradley, Canton, Ohio.

445,102. Electric Motor Reciprocating Engine Charles J. Van Depoele, Lynn, Mass.

445,103. Trolley Wire Clamp or Support. William Vogler, Somerville, Mass.

445,106. Electric Signal for Railroads. Edgar C. Wiley, Bristol, Tenn.

445,120. Machine for Covering Wire. George Lespenard, Brooklyn, N. Y.

445,136. Multiplex Arc Lamp. William H. Elkins, Cambridge, Mass.

445,142. Trolley Wire Support for Electric Railways. James S. Hughes, St. Paul, Minn.

445,144. Electrical Railway Car. Rudolph M. Hunter, Philadelphia, Pa.

The object of this invention is to provide a suitable construction whereby the motor may be positively geared or connected with the axles and yet be wholly supported by the car body and be arranged under the driver's platform in the front of the car whereby suitable trap doors may be provided by which the motor may be easily inspected.

445,146. Electric Switch. Benjamin B. Keyes, Chelsea, Mass.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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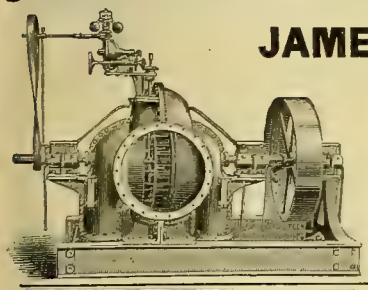

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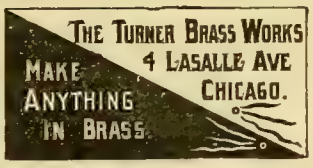

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Care WESTERN ELECTRICIAN.

The Electrical Commissioners of the District of Columbia invite communications from firms interested in electric cables, conduits, subways, etc. Also, upon the subject of municipal electric lighting, electric transmission of power, etc. Communications received until March 1, 1891. Personal interviews cannot be granted at present. Address, Electrical Commission, Room 30, District Bldg., Washington, D. C.

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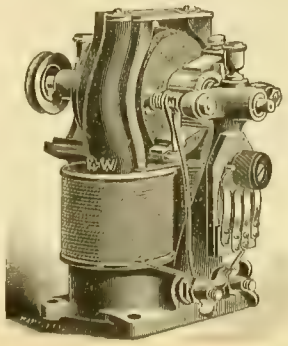

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Providence, February 17 to 19, 1891.

The Convention of this association will be held in Providence, R. I., February 17 to 19, for which occasion the Michigan Central—"The Niagara Falls Route"—will make a rate of one fare and one-third for the round trip, on the certificate plan, *i. e.*, you pay twenty-two dollars Chicago to Providence, and receive a certificate which will enable you to purchase a return ticket at seven dollars and thirty-five cents.

The cost of Sleeping-car berth each way will be five dollars and a half, between Chicago and Worcester.

These rates will apply to delegates, members of their families, or friends who desire to accompany them.

The Chicago delegation, after a careful consideration of the advantages offered by the various lines, has selected the Michigan Central, and will start from Chicago on their North Shore Limited Express, leaving at 12:20 noon, Sunday, February 15th, which train is due to arrive in Providence at 7:35 oclock the next afternoon.

The service on this train is unsurpassed, it being a solid vestibule train equipped with buffet, library, dining and sleeping cars, and in fact every convenience that the most exacting traveler could wish, thus insuring a most enjoyable trip.

Delegates from Western Cities are cordially invited to come to Chicago to join the Chicago Delegation.

Certificates to enable you to secure the reduced rates will be sent to you upon application to the undersigned.

While the committee are very anxious to have all Western delegates join them and go on this train, it might be well to state that the tickets at this rate will also be accepted on the Fast Atlantic Express of the Michigan Central, which makes through connection via the New York Central & Hudson River, Boston & Albany, and New York, Providence and Boston Railroads, arriving in Providence at 11:55 A. M. the second day.

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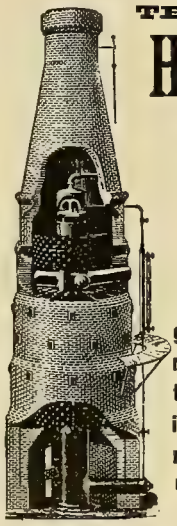

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List of all Isolated Electric Light Plants, with Number and Kind of Lights.

List of all Gas Companies, with Capital Stock, Officers, Price of Gas and Financial Standing, including all Gas Companies operating Electric Light Plants.

List of all Street Railway Companies, with Capital Stock, Officers, Miles of Track, Gauge, Kind of Rail, Number of Cars and Horses, Motive Power, if Electric, Cable or Steam, and Financial Standing.

List of all Telephone Exchanges and Licensed Companies, with Officers and Financial Standing.

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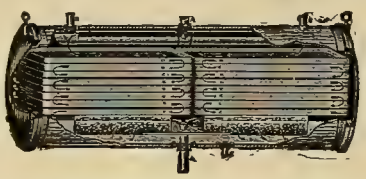

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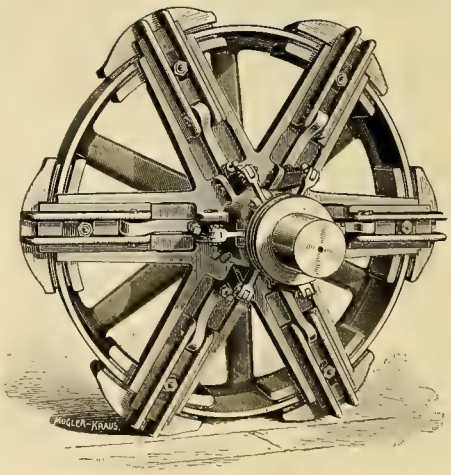

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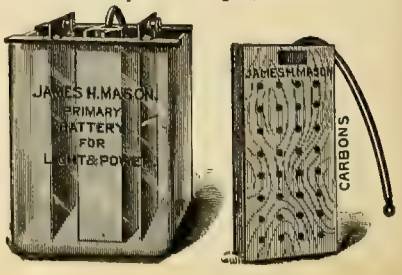
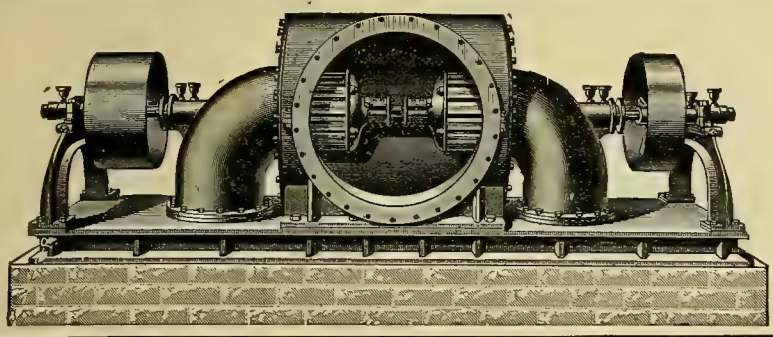


VICTOR TURBINE WATER WHEEL



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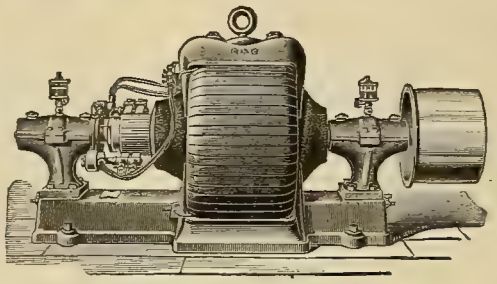

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No. 4.	.46 megohms.	65,000 ohms.	2,856 ohms.	1,600 ohms.	1,000 ohms.
No. 5.	3.5 megohms.	83,000 ohms.	0 ohms.	0 ohms.	0 ohms.
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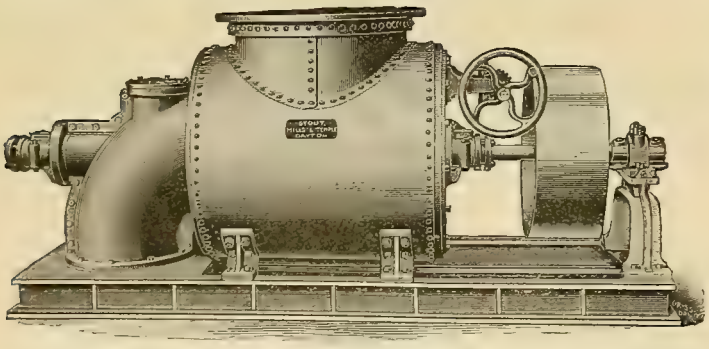

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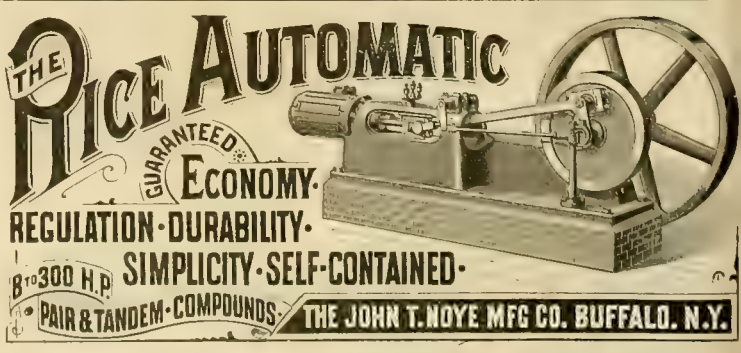

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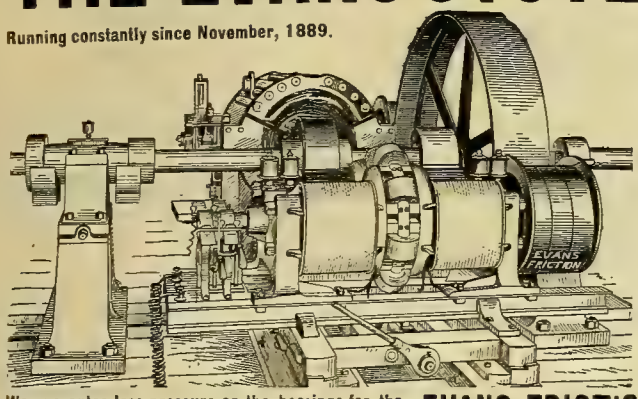

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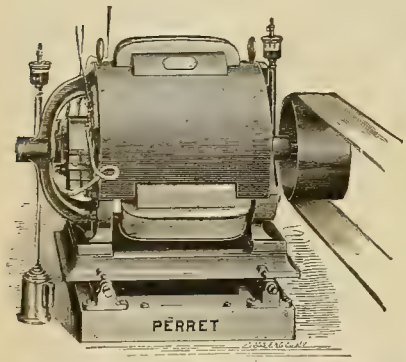

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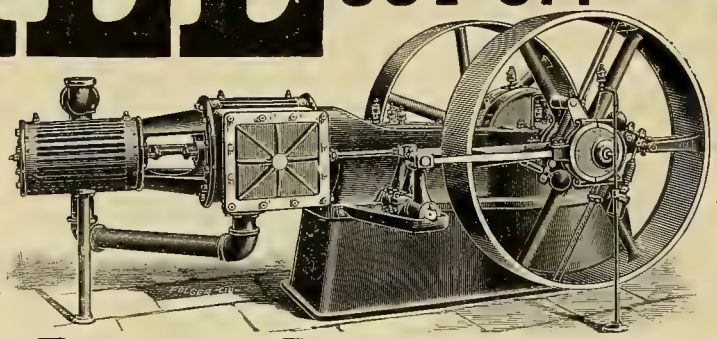

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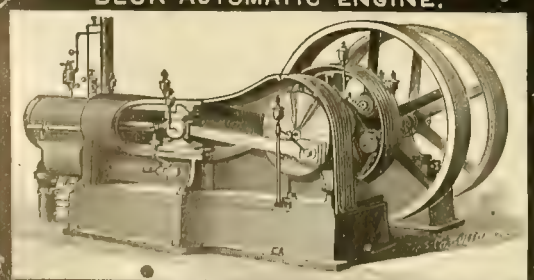

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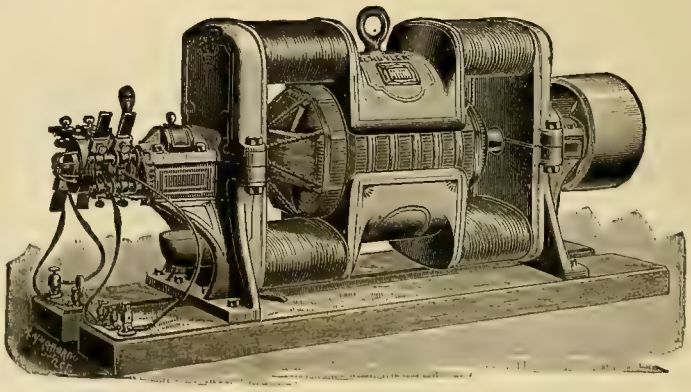

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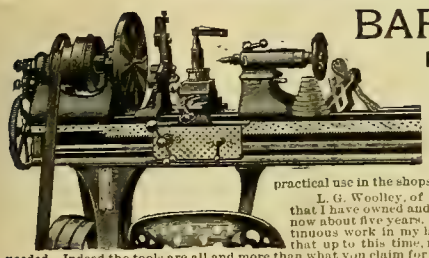

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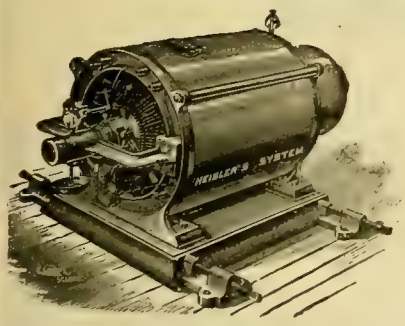

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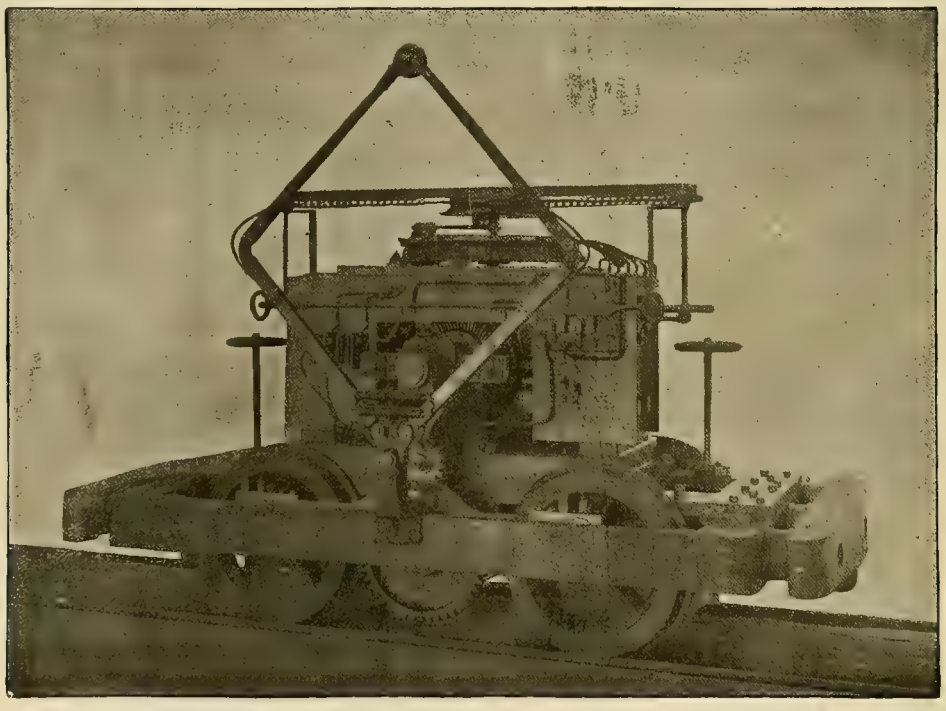

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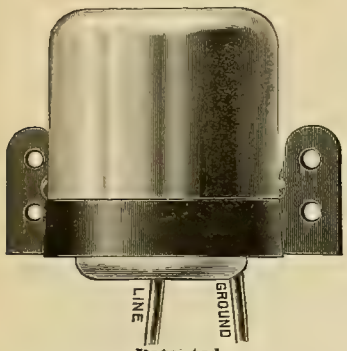

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☞There is no better time than the present to prepare for next season's lightning.

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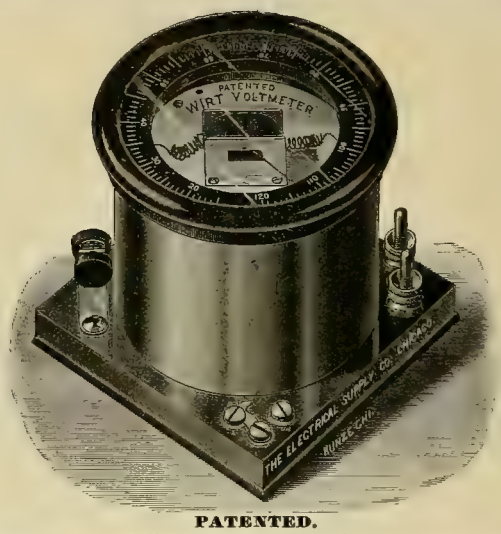

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Internal Resistance, .5 Ohms.

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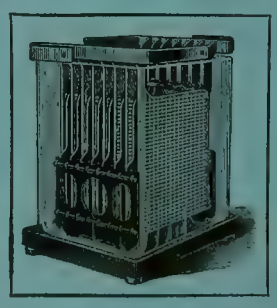

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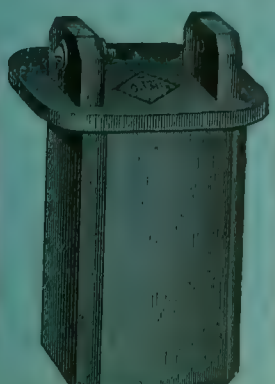

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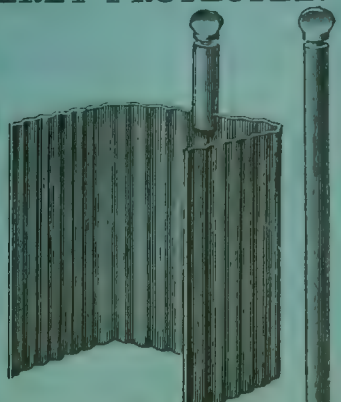

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DISTRICT OF COLUMBIA

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Brush Electric Co.
Consolidated Electric Storage Co.

Aluminum.
Cowles Electric Smelting & Refining Co.
Cleveland Aluminum Co.

Annunciators.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
GreatWestern Electric Supply Co.
Greeley & Co. E. S.
Hay Mfg. Co. Walter.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.,
Partrick & Carter Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Anti-Friction Metal.
Magnolia Anti-Friction Metal Co. The
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Brush Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
McLaughlin, Jas.
Northwest Thomson-Houston Elec. Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Bunnell & Co., J. H.
Central Electric Co.
Crosby Electric Co.
Electrical Supply Co. The.
Fletcher & Fletcher Electric Co.
GreatWestern Electric Supply Co.
Leclanche Battery Co.
Mason, J. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co. The
Holtzer-Cabot Electric Co.
Partrick & Carter Co.
Queen & Co.
Stanley & Hall.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co. E. S.
Hay Mfg. Co. Walter.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Wollensak, J. F.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., E. S.
Holtzer Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.
Standard Electrical Works.
Stanley & Hall.
Star Electrix Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.
Jewell Belting Co.
Mason, James H.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

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Hazelton Tripod Boiler Co.
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Electrical Supply Co. The.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Electrical Works.

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(See wire insulated.)

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Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

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Brush Electric Co.
Central Electric Co
Electrical Supply Co. The.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Stephenson Co., John.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain, Foree.
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Chicago Electric Mfg. Co.
Knapp Electrical Works.
McLaughlin, Jas.
N. W. Thomson-Houston Elec. Co.
Shawhan Machine Works.
Western Electric Co.

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Edison General Electric Co.
Hutton, Henry.
McLaughlin, Jas.
N. W. Thomson-Houston Elec. Co.
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Thomson-Houston Electric Co.
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U. S. Electric Lighting Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.
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American Electrical Works.
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Electrical Supply Co. The.
Great Western Electric Supply Co.
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International Okonite Co., The.
Illinois Electric Material Co.
Knapp Electrical Works.
Monitor Electric Co.
Roebling's, Jno. A. Sons Co.
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Standard Underground Cable Co.
Western Electric Co.

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Electrical Supply Co. The.
Great Western Electric Supply Co.
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Holtzer-Cabot Electric Co.
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Partrick & Carter Co.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Star Electrix Co.
Union Hardware Co.
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Western Electric Co.

Dynamos
Brush Electric Co.
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Heisler Electric Light Co
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Edison General Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.
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Bleckert & Nelson.
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Edison General Electric Co.
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Electrical Supply Co., The
Knapp Electrical Works.
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Wollensak, J. F.

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Automatic Switch Co.
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Chicago Electric Mfg. Co.
Cleverly Electrical Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co , The.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Ostrander & Co., W R.
Partrick & Carter. Co.
Southern Electrical Supply Co.
Stanley & Hall.
Star Electrix Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Turner Brass Works.
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International Okonite Co., The.
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International Okonite Co , The.
India Rubber & Gutta Percha Insulating Co.
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Electrical Supply Co., The
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Railways Electric.
(See electric railways.)

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Western Electric Co.
Wollensak, J. F.

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Queen & Co.

Springs.
Gibson Co., The W. D.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
Illinois Electric Material Co.
Western Electric Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
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Partrick & Carter Co.
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Queen & Co.
Western Electric Co.
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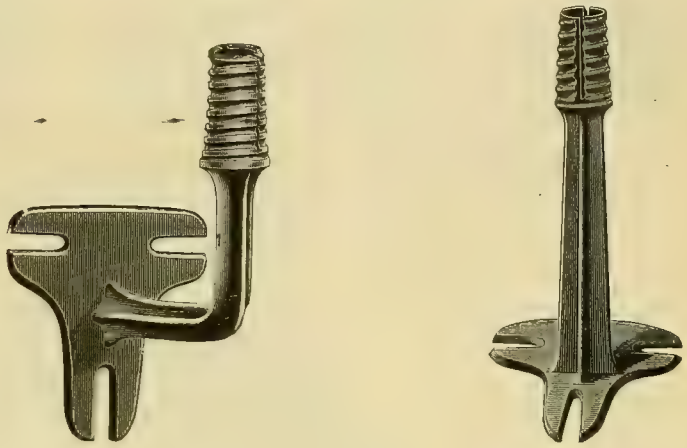

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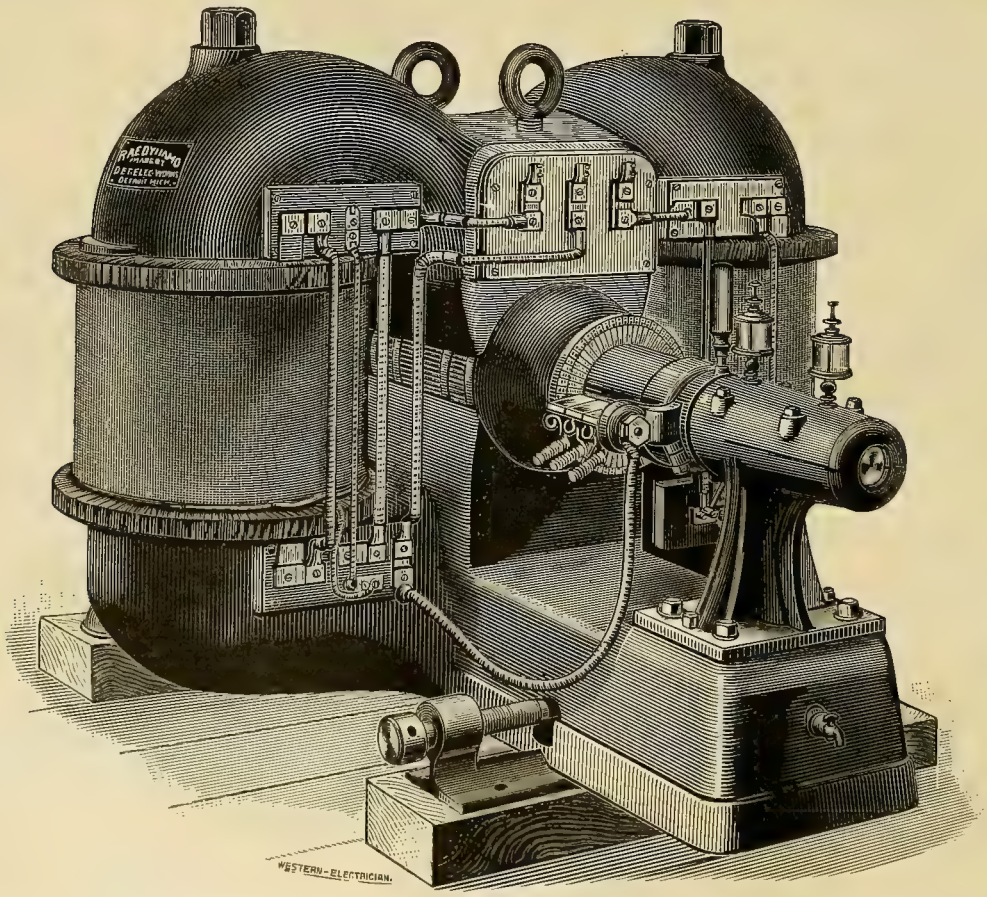

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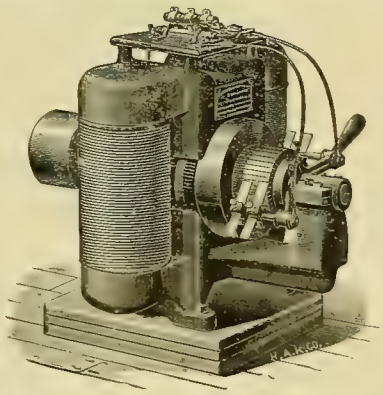

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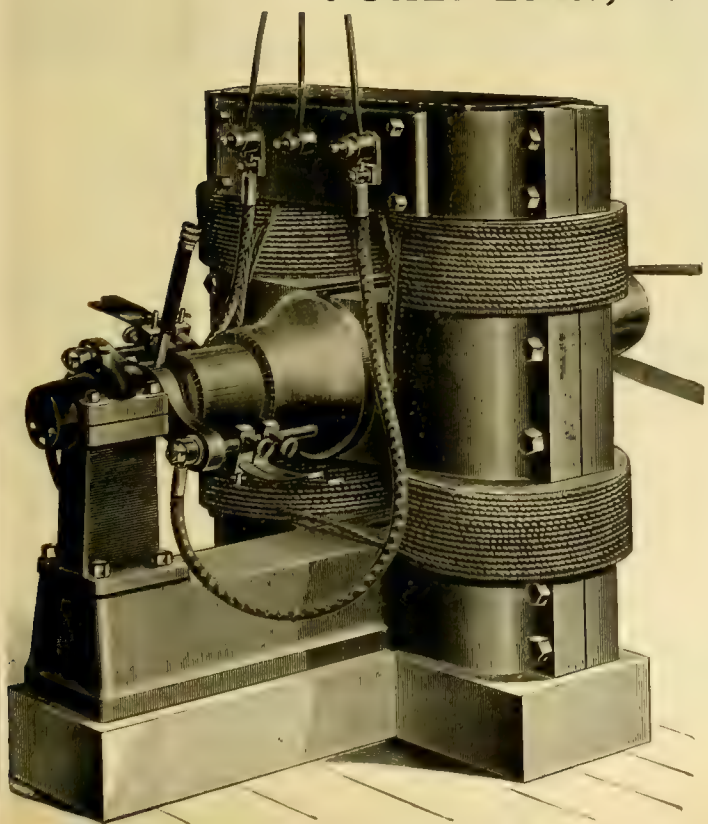

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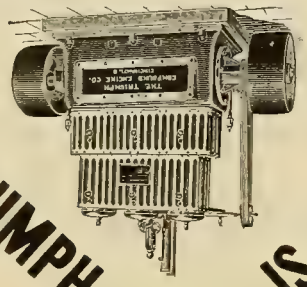

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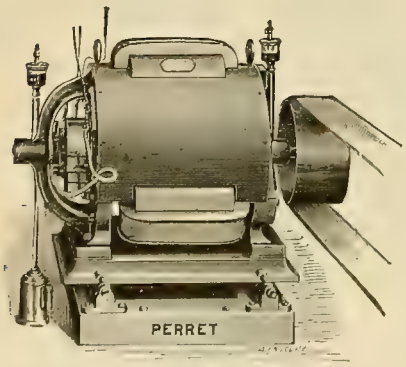

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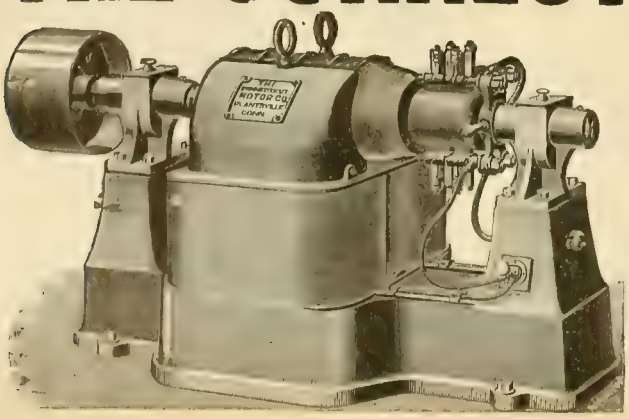

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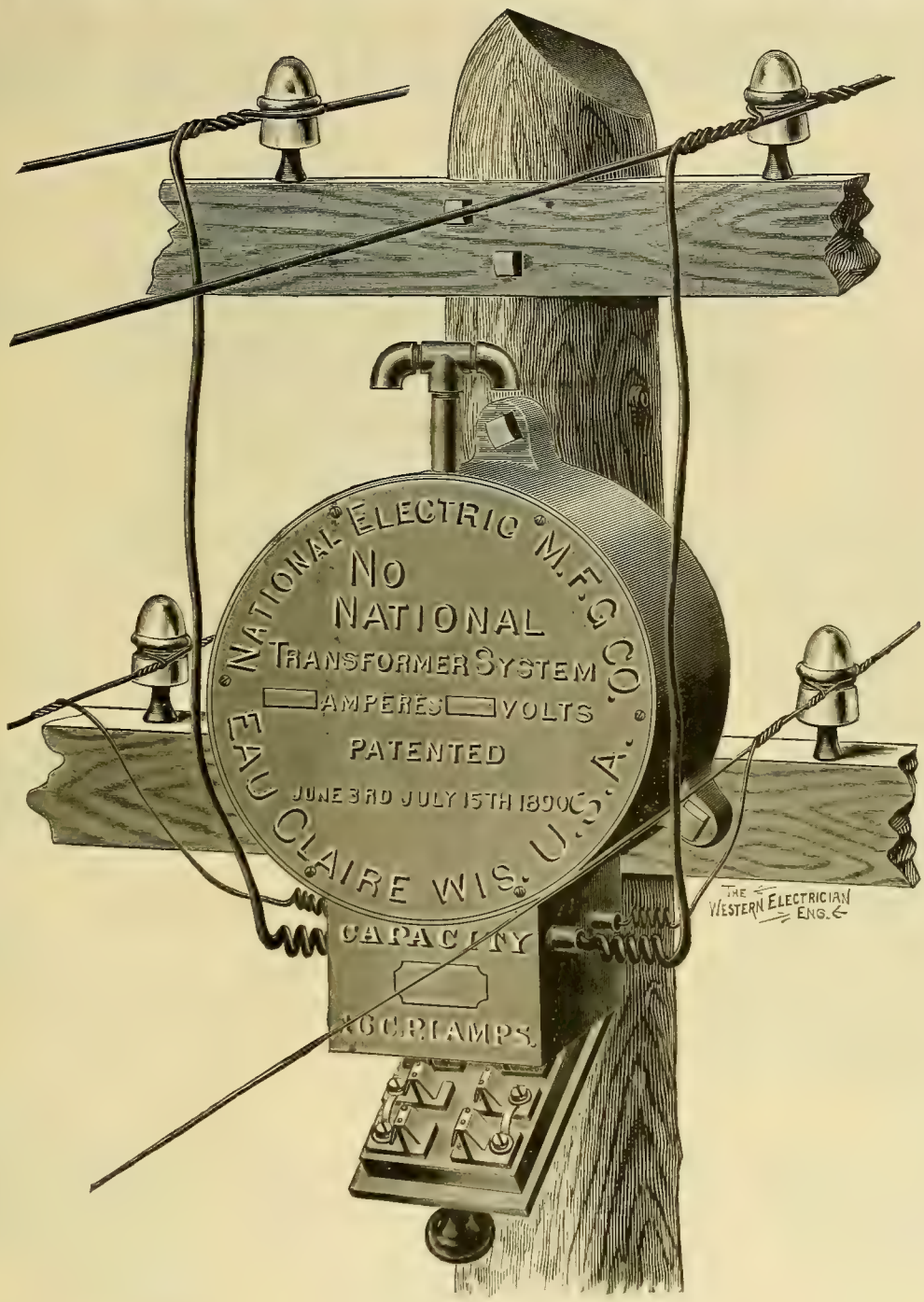

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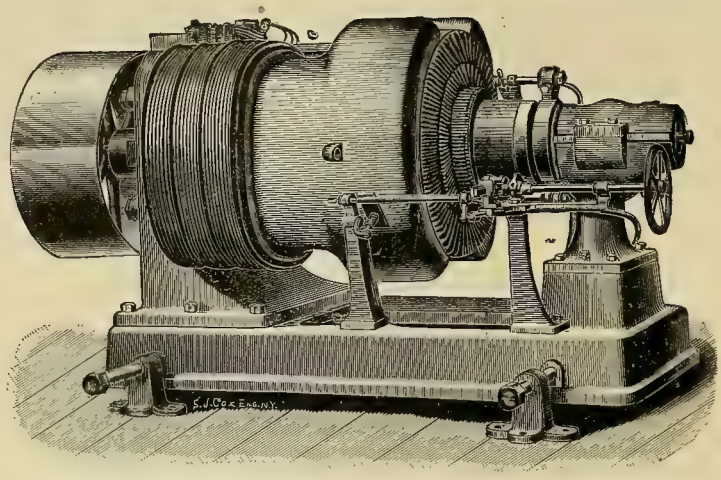

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THE GENERATOR,

EXCELLENT IN ELECTRICAL DESIGN.

Simple and strong mechanically; Large, well balanced, well ventilated armature; Sectional field windings.
Regulation automatic, regulator simple, and on the machine;
No extra circuits, no wall resistance.

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1,200 and 2,000 candle power; Lamps for 7 or 14 hours' continuous burning as desired.

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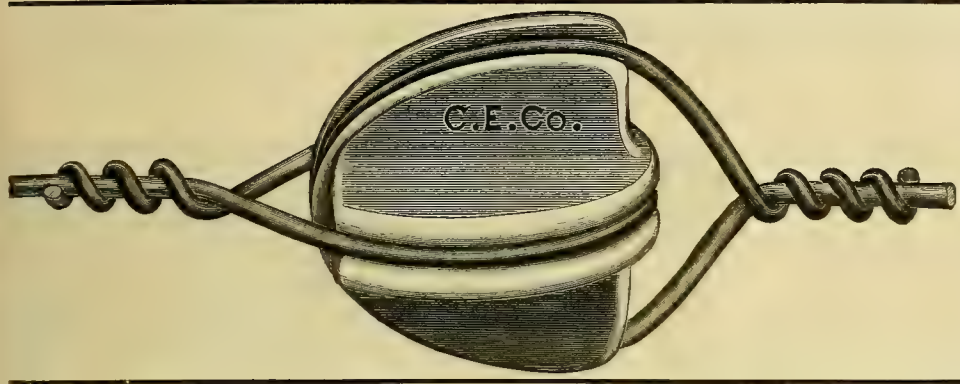

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For Suspending Arc Lamps, Insulating Guy Wires, Insulating Span Wires in Electric Railroad Work, is so simple and perfect in construction as to need no explanation.

THIS NEW
HIGH RESISTANCE GLASS
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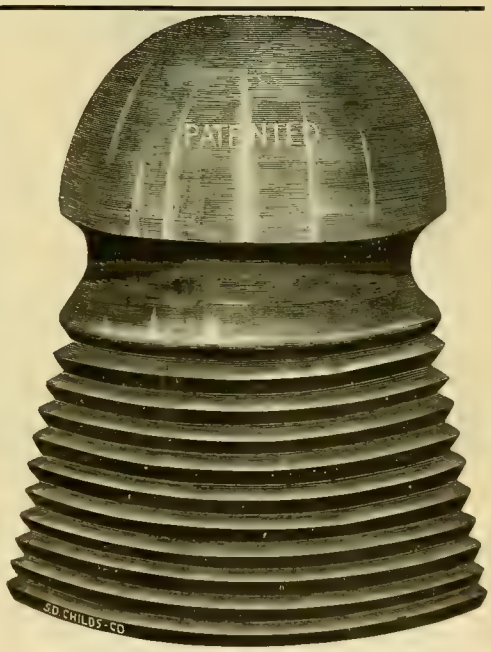

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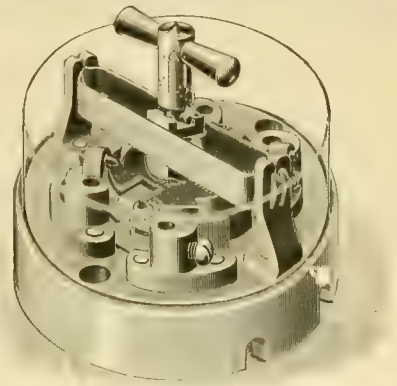

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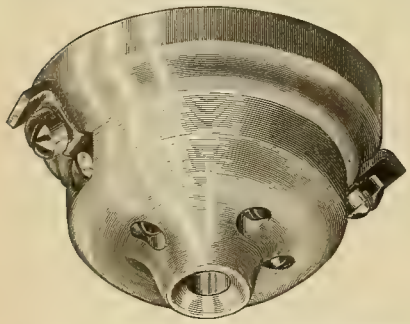

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YOU WILL BE "IN IT" IF YOU SEND YOUR ORDERS NOW.

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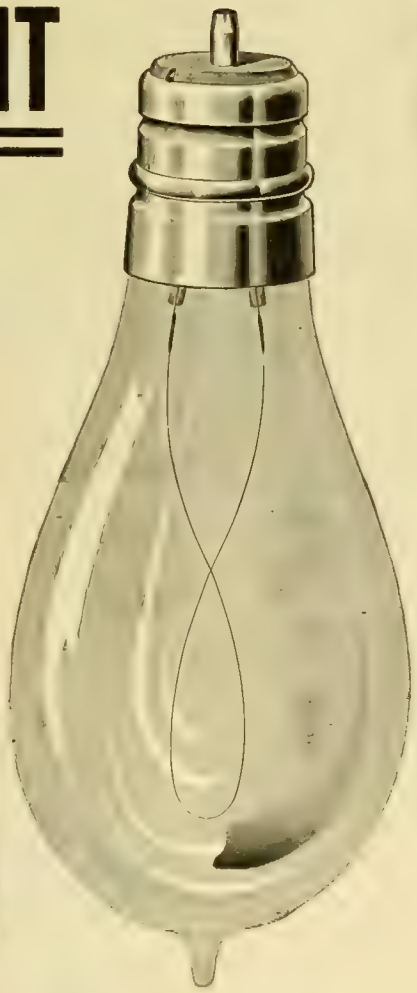
Excelling all others in Life, Maintenance of Candle-Power and Efficiency.

Even Diffusion of Light by twisted filament.



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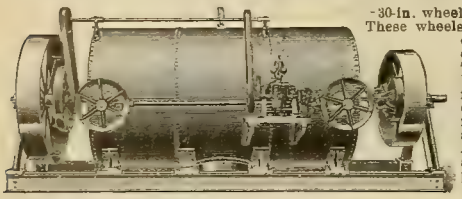
Turbine Water Wheels, Vertical & Horizontal.



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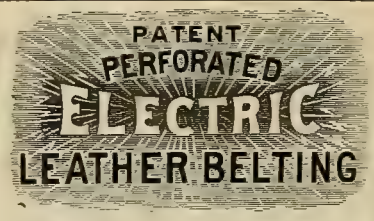

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February 1st, Prices go away down on the

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BETTER than any Dry Battery yet produced.

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Western Electrician.

EVERY SATURDAY.

Vol. VIII. CHICAGO, FEBRUARY 7, 1891. No. 6

Franklin S. Terry.

Among those connected in a commercial way with electrical interests in the West few young men are better known than Franklin S. Terry, manager of the Electrical Supply company, Chicago. Mr. Terry has been a resident of Chicago seven years. During this time he has built up a successful business, and has formed a wide circle of friends by no means confined to the West.

Mr. Terry was born at Ansonia, Conn., in 1862, and early entered the local high school, where he was graduated at eighteen. As his father was a physician it was decided that the son should be educated to the same profession. With this end in view he completed studies preparatory to a collegiate course. During the summer vacation prior to the college term, Mr. Terry accepted a temporary position in the office of Wallace & Sons. Here he developed so marked an aptness for bookkeeping and general clerical work that he attracted the attention of the promoters of the Electrical Supply company, then recently organized. He was induced to abandon a professional career and devote himself to business. Mr. Terry began his commercial life in charge of the office and books of the Electrical Supply company in 1880, and for four years he remained in that position. He had ample opportunity to formulate and execute many of the innovations and improvements in office economy, which have been characteristic of his methods in the management of his company from the first.

In November, 1884, the Electrical Supply company determined to open a Western office and warehouse in Chicago. Mr. Terry, as the most available man, was sent to the city to make the necessary arrangements, and to take charge of what was soon to become under his management one of the largest supply houses in the country. He opened the first warehouse in the second story of the building at 175 Lake street, where he continued for one year. Finding his facilities inadequate to the rapidly increasing business, he moved into larger quarters at 171 Randolph street, where, with additional storeroom, the Western headquarters of the Electrical Supply company have since been located. That the volume of business transacted by this company has steadily increased each year since its establishment, is the best evidence of the executive ability of the manager.

Although, as he admits, Mr. Terry's knowledge of electricity is confined to its commercial side, the electrical fraternity is indebted to him in no small degree for introducing many improvements of merit which would have been unknown but for his insight into the needs of the times.

Early in 1885, after a few months' residence in Chicago, Mr. Terry, with several others, formed the plan of organizing an electric light association, and was instrumental in urging upon the fraternity the benefits that would result from the formation of such an association, from concentrated action and the personal acquaintance of those engaged in similar interests. It was largely through his efforts that the first convention of what is now known as the National Electric Light association was held in Chicago.

Mr. Terry was one of the organizers and charter members of the Chicago Electric club. He was elected the first treasurer, and has held the position ever since.

In 1886 Mr. Terry married Miss Grace Downes of Birmingham, Conn.

FRANKLIN S. TERRY.

Ventilating Conduits in Chicago.

The recent explosion in a manhole in Chicago, which resulted so disastrously, has directed public attention to the fact that the gas companies are perpetrating an outrage upon the community by failing to maintain properly constructed gas mains. City officials have had the matter under advisement, and while it is fully realized that the gas companies should be compelled to remedy the evil, the fact is recognized that immediate steps should be taken to relieve the present condition of affairs. It has been decided to introduce a comprehensive system of ventilating subways, and the engineering department of the city government is now engaged in considering several schemes for this purpose.

"It is an outrage that the city should be called upon to rid the conduits of gas, which these companies pour into the subways," said City Electrician Barrett. "It is, however, an absolute necessity that some remedy be applied immediately, and I know of no way to accomplish this unless the city steps in and does the work."

National Electric Light Association.

It is proposed to hold a special session at the convention of the National Electric Light association at Providence to celebrate the completion of the first decade of the commercial use of electricity for light and power. In all probability the morning session on Wednesday, February 18th, will be designated. The association invites all pioneer workers in electrical undertakings to participate in this celebration by their presence and by contributing for publication over their signatures an account of some interesting episode in their early experiences with electrical work. The memorial session will be devoted exclusively to the recitation of such remembrances. All contributions will be published in the volume of proceedings after the convention, and will thus form a memorial of the beginnings of the electrical industries.

The following persons as representatives of the principal departments of electrical development have been invited to participate in the celebration: Telegraphy, Dr. Norvin Green; ocean telegraphy, Cyrus W. Field; telephoning, Alexander Graham Bell; arc lighting, Charles F. Brush; incandescent lighting, Thomas A. Edison; electric street railroad, Hon. Henry M. Whitney; electric welding, Prof. Elihu Thomson; technical education in electrical engineering, Gen. Francis A. Walker; steam engineering for dynamo driving, Gardiner C. Sims; organization of the National Electric Light association, George W. Worthington.

On February 18 M. J. Perry, president of the National Electric Light association will give a reception in Spink's Hall, Broad street, Providence. Some of the prominent citizens of Providence will be invited to meet the delegates and the ladies accompanying them at that time. The Hungarian band will furnish music for the occasion. The reception committee will consist of the following gentlemen: Eugene F. Phillips, William G. Nightingale, Herbert Warren Ladd, Richard F. Deming, Albert C. White, James Richardson, Jr., George H. Wood, Gardner C. Sims, Henry A. Villard, Elisha Dyer, Isaac N. Potter, William S. Hayard, Homer M. Daggett, Jr., Mortimer H. Hartwell, William Ames, Henry R. Barker, Arthur S. Watson.

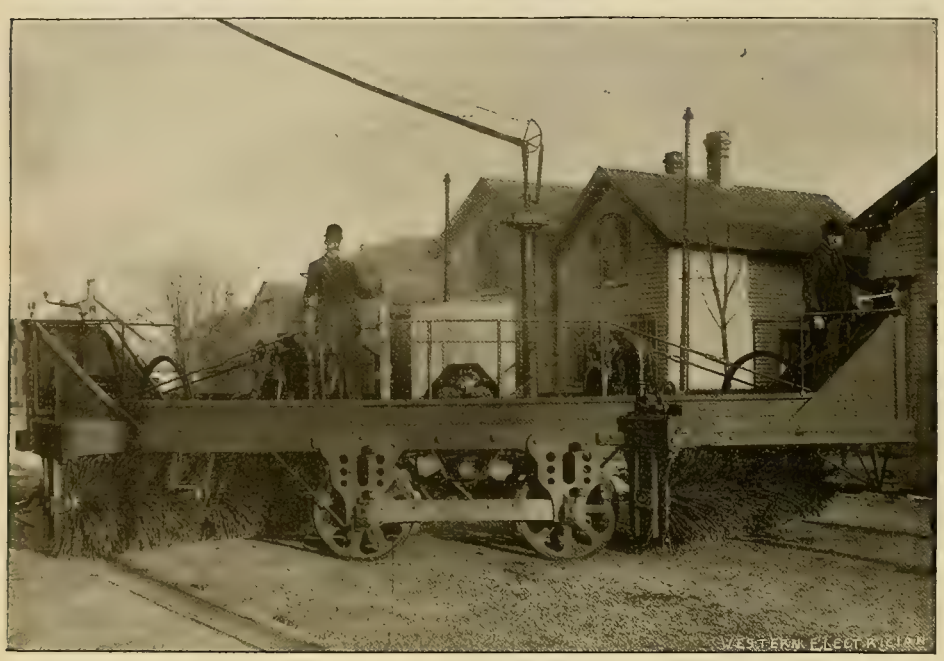
Mercantile Telegraph Company.

The Mercantile Telegraph company has been incorporated at Chicago; capital stock, $100,000; to transmit intelligence to a distance by means of electricity, to construct telegraph lines between the respective States and Territories of the United States, and to engage in a general telegraph business: incorporators, Julius Schwiezer, George Einstein and Henry H. Kennedy. George Einstein, one of the three applicants for a license, said regarding the new company that he was simply representing the incorporators. The men who are back of the company do not wish their names made public as yet, but Mr. Einstein says that the company is a legitimate one, and that it has been formed for the purpose of constructing, maintaining and operating a system of telegraph lines. Where the lines are to run he would not say.

Columbia Snow Sweeper.

The accompanying cut illustrates a new snow sweeper constructed for use on the St. Paul & Minneapolis street railways.

The car frames were built by the St. Paul City Railway company and the motors by the Columbia Electric company of St. Paul. The car is driven by one 30-horse power motor, connected by sprocket gear to the axles of the car.



COLUMBIA SNOW SWEEPER.

Friction wheels may be used as shown in the cut, but this construction necessitates a greater expenditure of power. This gearing, however, makes no perceptible noise. A rheostat is placed below the car bed to control the motor and it is so arranged that any speed desired can be obtained up to a maximum speed of fifteen miles per hour. One 10-horse power motor of the regular Columbia type is used to drive each brush, one rheostat controlling both motors. The brushes are run direct from the motor, with sprocket and chain. The car is open, the motors only being covered. The covers of the two smaller motors are movable and the large one is accessible through doors. The car is lighted with a cluster of six lights on the trolley turret and one at each corner of the car.

This sweeper will, it is claimed, remove snow of from three to twelve inches deep. In case of very deep drifts the car will run at very slow speed and the brushes at high speed and thus cut its way.

A special advantage claimed for the Columbia sweeper is the placing of the motors above the car bed, so as to protect them from moisture and at the same time enable the motor man to take proper care of them.

The Westinghouse Company's Affairs.

The following special dispatch was sent to the WESTERN ELECTRICIAN from Pittsburg, Pa.: Mr. Westinghouse has returned from New York where he had been engaged in negotiations in reference to placing the preferred stock of the Westinghouse Electric Manufacturing company. He reports that the amount subscribed for and promised, aggregates 30,000 shares. This subscription is conditioned upon the total of 40,000 shares being subscribed for by creditors and others. It will require at least half a million dollars in cash. He says negotiations are pending for the subscription by other stockholders of an amount sufficient to carry out the plans he has had in view. Owing to the delays and interruptions which have taken place he proposes to have the time for the making of subscriptions extended until the 15th of the month, feeling confident that the fifteen additional days will suffice to put the affairs of the company in good shape.

The Wheeling, W. Va., Electric Light & Power company is erecting a new power house.

Electric Lighting in McVicker's Theater, Chicago.

The contract for installing the electric light plant in McVicker's theater, Chicago, has been awarded to the Chicago Edison company. It was in McVicker's theater that the first electric plant for theatrical work was installed in the West, and it is also supposed to have been the first in the country in which electric lighting was used exclusively. Mr. McVicker had great confidence in the new light from the start and as soon as his plant was ready he ordered his gas meters taken out. He has not regretted it and to-day he is as enthusiastic for electric lighting as ever.

Since the fire in the theater last summer Adler & Sullivan, the architects, have been engaged on plans for the new building. The electrical equipment will, they say, be superior to that of any theater in the country. Mr. Sullivan, who has given the matter of the arrangement of the lights his personal attention, says he will introduce several novel features and that the stage effects will be superb. Louis A. Ferguson, electrician of the Chicago Edison company, will have personal supervision of the installation.

Telephone Rates in Chicago.

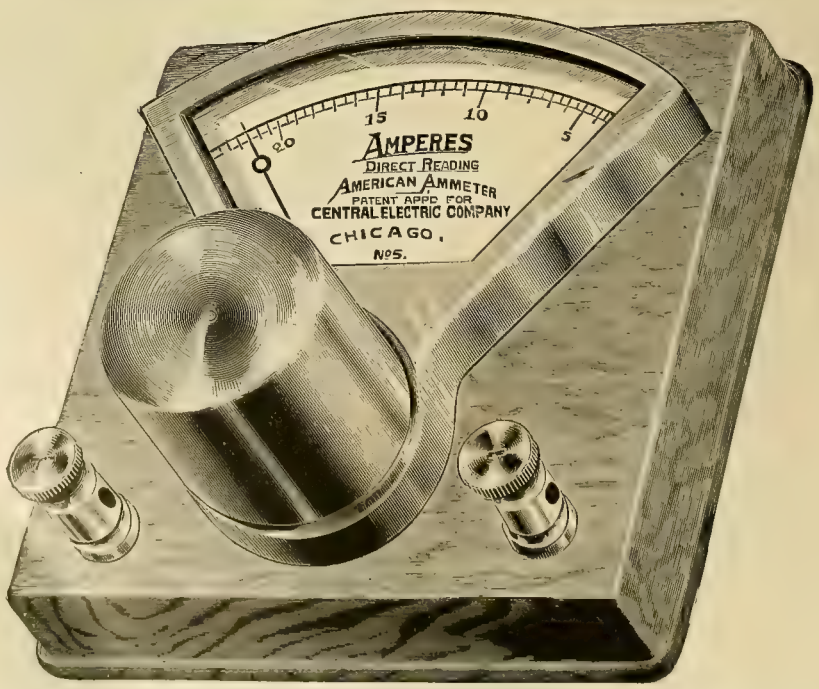
The Chicago druggists, who have been agitating the question of securing a reduction in telephone rates, have prepared a circular for distribution among the subscribers to the Chicago Telephone Exchange, urging them to cooperate with Senator Thiele in his efforts to get a bill through the Illinois legislature. Senator Thiele is a member of the Druggists' Association, and the telephone question is a hobby with him. The subscribers have decided to appeal to druggists and other telephone users throughout the state to use their influence with the members from their respective districts to co-operate with Mr. Thiele. They urge that all citizens and all classes are interested in this matter. The local subscribers have appointed a committee of fifteen to assist in this work.

It has been decided to send the following named gentlemen to Springfield to support the bill and look after its interests: Soren Mathison, W. K. Forsyth, William Bodeman, D. R. Dyche, T. N. Jamieson, and R. C. Freksen. They will visit the state capital as soon "as the legislature selects a United States senator" they say. At present, there is, therefore, little probability that they will be called upon for some time. The gentlemen identified with this movement have issued a circular in which they say they are in no way connected with the "Subscribers' Telephone Company," which recently endeavored to enter the field in Chicago. They have, however, been prominent in other movements, that of two years ago evidently giving them much hope.

New Electrical Testing Instruments.

Many electrical plants are operated without the aid of suitable testing appliances on account of their great expense. To meet this want the Central Electric company, Chicago, is placing upon the market a new voltmeter and ammeter, which are claimed to be as accurate as the most expensive instruments in use.

The cut shows the form of these instruments. They are finely finished, and are supplied in handsome hardwood boxes. The instruments combine the qualities of convenience, accuracy, and durability, with simplicity. They are made on correct scientific principles, have been, it is stated, severely tested by scientific experts, and pronounced strictly accurate and thoroughly reliable. No permanent magnets are employed, and only the softest iron is used in the electromagnets. By an arrangement of the coil and iron, residual magnetism is reduced to a minimum, thus securing the greatest possible accuracy. The springs are of the best steel, and

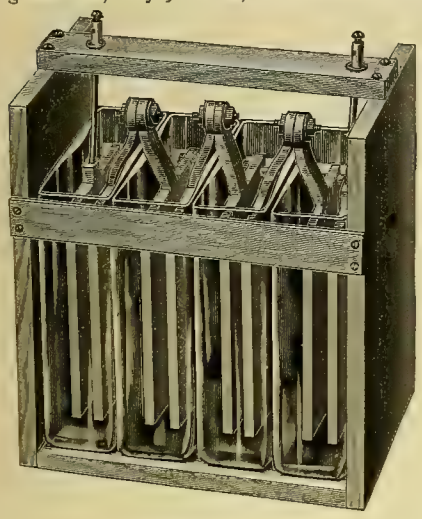


NEW ELECTRICAL TESTING INSTRUMENTS.

have been aged insuring permanency and reliability. The pointer pivoted on polished steel needles is very sensitive, and when set for any point will stop at this point when at rest. The voltmeter is exactly similar in appearance to the ammeter.

Midget Storage Battery.

To meet the demand for a cheap and thoroughly reliable storage battery for running lights, small motors, experimenting, and a variety of other purposes, the Electrical Supply company of Chicago has introduced the Midget storage battery, shown in the cut. The battery, it is stated, is as carefully made as any of the standard cells. The batteries are furnished in glass cells, 6 by 9 inches, and each cell has a



MIDGET STORAGE BATTERY.

capacity of 20 ampere-hours. The e. m. f. is 2 volts and the maximum rate of discharge is 4 amperes.

These batteries are sent out without the liquid, which may be prepared as follows: To 9 parts pure water add one part, by weight, of pure sulphuric acid. Allow the fluid to cool before placing it in the cell. A current of not more than 2 amperes should be used for charging as soon as the liquid is introduced, and continued until the cell is fully charged.

The Chicago Electric Motor company has been organized to manufacture electric motors, dynamos, etc.; capital stock, $250,000; incorporators, Barron D. Southard, James H. Dean and Edward H. Manship.

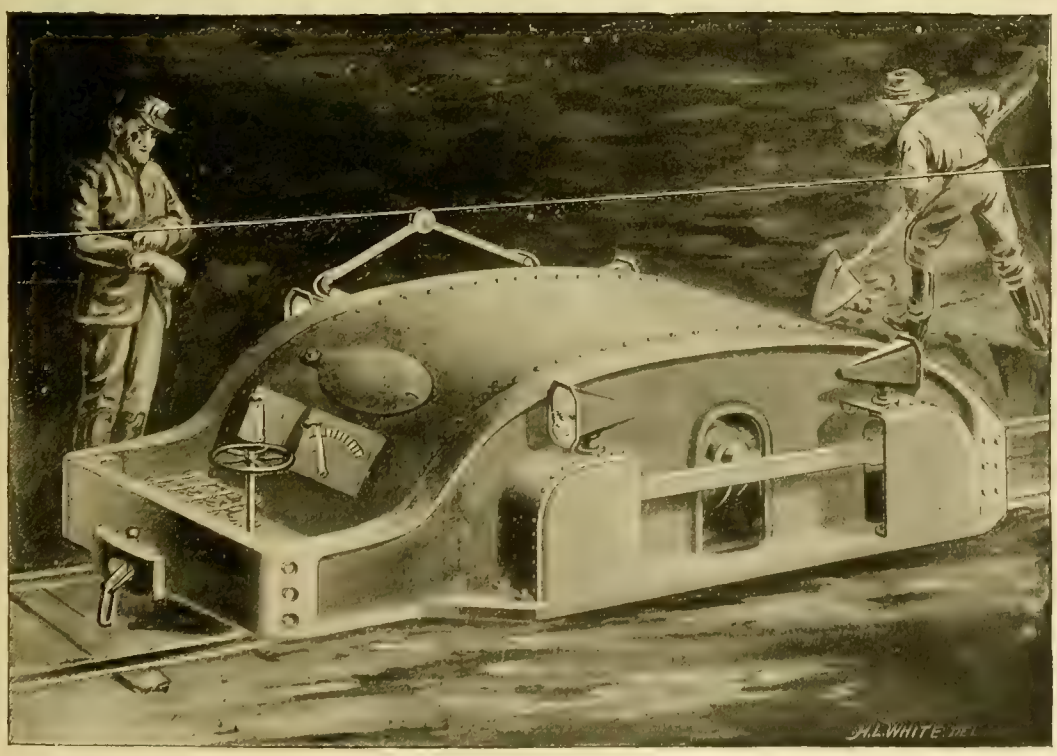
Chicago Edison Company.

An idea of the popularity of incandescent lighting in Chicago may be gained from the fact that during the last year the Chicago Edison company added to the load in its Adams street station 12,000 lamps, an average of 1,000 per month. The company now has 29,000 lamps actually connected up, besides 950-horse power in motors. At the present time there are several large contracts under way and the capacity of the station will be taxed to its utmost. The company is operating twenty dynamos now and it is believed the next addition to the plant will be in much larger machines than those now in use. The work on the South side station has been greatly delayed by the labor troubles in Chicago, but it is expected the station will soon be in readiness. The company is now wiring the Hotel Metropole, Michigan avenue and Twenty-third street, for 2,400 incandescent lights. Current will be furnished from the South side station of the Chicago Edison company.

New Mining Locomotive.

The accompanying illustration shows the new type of Thomson Van Depoele electric locomotive for underground work. The signal success of earlier mine haulage installations has shown the important place which electricity is destined to occupy in this field of work. The machine shown is of 60-horse power capacity, and has a total height of thirty-nine inches from the top of the rails. It is built to operate on tracks of varying gauge from thirty-six inches to the standard four feet, eight and one-half inches.

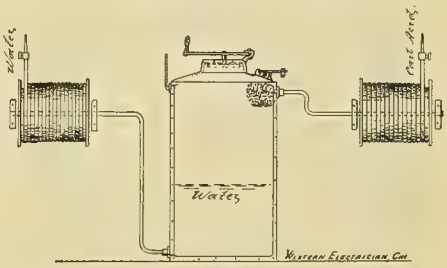
All the controlling devices are located at one end, and as the body of the locomotive is so low that the view is unobstructed in either direction, the operator is not obliged to change his position in reversing the motion of the locomotive. A headlight with a parabolic reflector which is provided at each end, makes the track clearly visible for a considerable distance. The trolley is of the double elbow pattern which has been found to be admirably adapted to mine work in previous installations. It accommodates itself to the varying heights of the trolley wire within any reasonable range. The sheet-iron covering makes a complete water-tight armor which protects the moving parts from falling rocks or bodies of ore and coal. The illustration shows the locomotive in an enlarged chamber, but about to enter a tunnel whose height from top of the rail is scarcely four feet, hence the depression of trolley wire as shown. The locomotive, which is built in several sizes, is introduced by the Thomson-Van Depoele Electric Mining company, Boston.



NEW MINING LOCOMOTIVE.

Fire Extinguisher for Telephone Switch-Boards.

Fires in telephone switch-boards are, at the present time, by no means of rare occurrence. From the start the electric light wires have been a source of annoyance and loss to telephone companies, but since the introduction of the overhead system of electric railway a number of the companies have been awakening to a realization that there must not only be provided safety devices to break circuits when an abnormal current flows, but that exchanges must also be provided with thoroughly efficient fire extinguishers. At first sight it may appear that a reel of hose and a good water supply would be all that was necessary to take care of the com-



FIRE EXTINGUISHER FOR TELEPHONE SWITCH-BOARDS.

paratively small conflagrations which occur. It must be remembered, though, that water in a telephone switch-board might perhaps be considered, in one sense of the word, at least, as bad as fire. The construction therefore of an extinguisher which could be relied upon to put out a small fire in a telephone exchange without leaving the insulation damaged by water, is a problem by no means easy of solution. Among the telephone men who have undertaken to solve this problem is J. J. O'Connell, electrician of the Chicago Telephone Company. Mr. O'Connell proposes to equip the switch-boards with apparatus of which the illustration is a diagrammatic representation.

The action of the extinguisher is based upon the fact that carbonic acid will extinguish flame and will not affect insulation. Referring to the cut the construction of the device will be understood at a glance. At the center is a tank, and on each side of it is a reel of hose connected with it by pipe, as shown. The tank is partially filled with a solution of soda in water, and is provided at the top with an easily sealed opening, through which an open vial of sulphuric acid may be dropped. The opening in the pipe to the right hand reel is filled with sponge, as shown, so as to prevent spray from entering this side of the extinguisher.

To operate the device the open vial of sulphuric acid is dropped into the tank through the hand-hole at the top, and this opening is immediately sealed. The mixing of the sulphuric acid and the soda solution forms carbonic acid, and creates a pressure within the tank. This pressure is utilized to force upon the flames either the gas or water.

Novel Telephone Service.

An exchange informs us that the latest telephone scheme is the organization of a "lost child" telephone service. The idea, it is stated, is kindly seconded by the telephone people everywhere, and has already given proofs of its instrumentality. It is evident that a warning of "lost, stolen, or strayed," put into six or seven hundred telephones, will set agoing with excitement a pretty large town, and even on a more limited plan is likely to track the wandering innocent in an hour or two.

"Electric Lighting in Connection with Gas Lighting: Comparative Prices and Profits of Each," will be the subject of a paper by J. J. Walsh, Paris, Tex., before the Southwestern Gas assocaiation's annual meeting at San Antonio, Tex., March 10 and 11.

Secondary Battery.

The work of developing the storage battery is still progressing, and we are constantly hearing of modifications which are claimed to be improvements over the well-known types. Among the experimenters who have done considerable work in this field is C. F. Brush of Cleveland, O.

A process which Mr. Brush has lately patented consists in producing upon the frame or grid of the element an electro deposited active coating of peculiar character, and then immersing the plate in an electrotype in which the

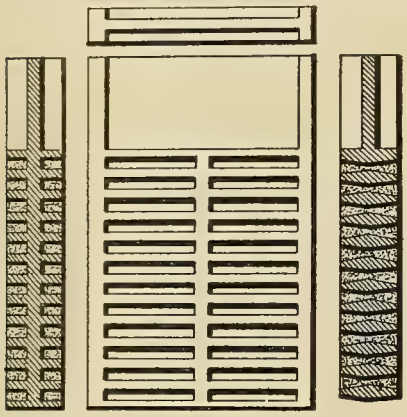


FIG. 1. SECONDARY BATTERY.

coating is insoluble, and after this peroxidizing the coating by electrical action.

The spongy lead is deposited upon a grid shaped, say, as in Fig. 1, as in any ordinary process of electroplating, the lead plate being first made chemically clean and the plating solution, consisting of acetate or nitrate of lead, or of sulphate of lead dissolved in any suitable neutral saline solution—such, for instance, as that of common salt. Any solution of lead may be employed provided that it is such as to produce a spongy deposit of metal. It is advisable to deposit the spongy metal very slowly in order that it may have sufficient compactness to retain its position. A simple method of fitting the spaces in a plate with lead sponge is represented diagrammatically in Fig. 2. The plate to be filled is first thoroughly cleaned, and the grooves on one of its sides are filled with sulphate of lead, either dry or made into a paste with water or saline solution. The plate is then placed horizontally with its prepared side up in the vessel containing a solution of common salt or of ammonia or other salt, in which sulphate of lead is somewhat soluble. In the solution, and connected to the plate, as shown, is a piece of zinc. Electrical action is at once set up, by which the sulphate of lead is gradu-

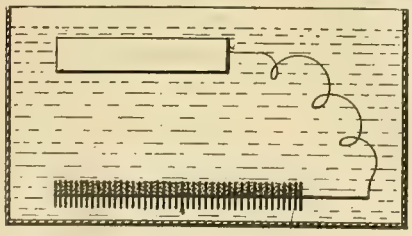


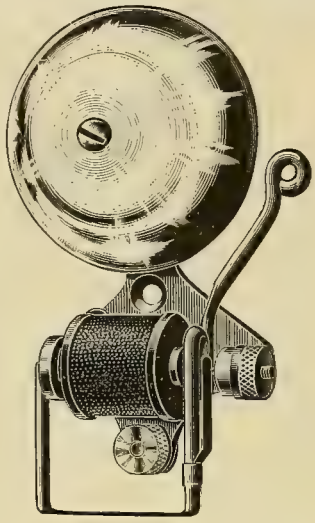
FIG. 2. SECONDARY BATTERY.

ally reduced to the metallic state, while an equivalent quantity of zinc passes into solution as sulphate. When one side of the plate is finished, the other side may be treated in the same manner. Finally, the zinc salt is thoroughly removed from the spongy metal by soaking in pure water or water acidulated with sulphuric acid. When lead plates, filled with spongy lead, as described, are associated together in a secondary battery and charged, the spongy metal of one of the plates is easily and rapidly peroxidized, while the spongy metal of the other plate at the same time absorbs a very large quantity of hydrogen. Thus is produced, it is claimed, a secondary battery of large capacity, and recourse to a tedious forming process becomes unnecessary.

It may be stated, however, that experiment shows that in a secondary battery having plates as above described the hydrogen-plate is apt to deteriorate to some extent after a time. This defect may be remedied or avoided in the first place by thoroughly peroxidizing both the plates instead of the oxygen-plate only, and then reversing the charge in one of the plates, by which its peroxide is reduced to the metallic state, thus again producing a hydrogen-absorbing plate, but in a better condition than before.

Electric Bell.

The cut presented herewith illustrates an electric bell recently placed on the market by the

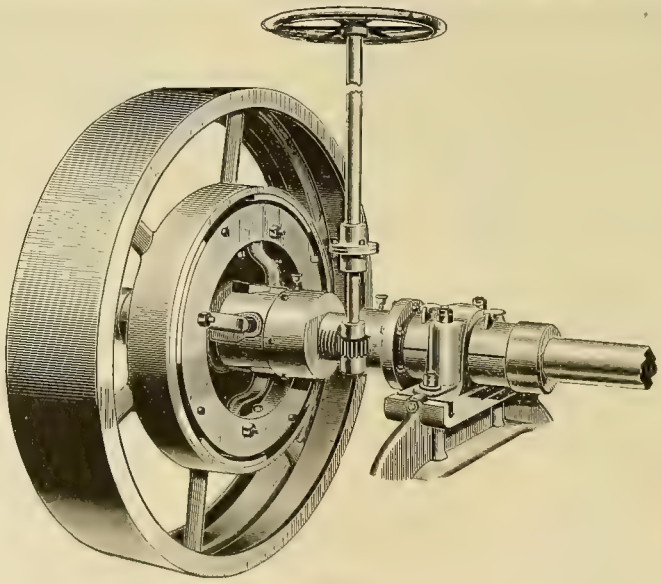


ELECTRIC BELL.

Walter Hay Manufacturing company, Chicago. The mechanism of the bell is quite simple, and, it is claimed, it will give good results with one cell of battery on circuits where before it has been the practice to employ two cells. It will be noticed that the binding post at the right also serves as a check nut to hold in place the contact screw. The frame of the bell is cast of soft iron, and is neatly japanned and nickel plated.

Rice's Friction Clutch Pulley.

The device illustrated herewith was invented by A. C. Rice, superintendent of the works of the Stilwell & Bierce Manufacturing company, Dayton, Ohio.



RICE FRICTION CLUTCH PULLEY.

The engraving represents one of the clutch pulleys in perspective, attached to a shaft and thrown into gear; the clutch is shifted in and out by means of an upright shaft terminating in a pinion which engages in a rack cut in the side of the shifter sleeve extension. This shaft is provided with a hand wheel, and may be extended so as to operate the clutch from any floor above or below. The ordinary shifter fork and lever can also be used. The clutch is provided with four metal friction shoes, which are simultaneously operated by the four crooked shifter arms. Each of these shifter arms is fulcrumed on an eccentric bolt, the end of which only is seen. The center of each friction shoe is out of line with its corresponding eccentric bolt. The effect of this construction is that when the friction shoe is thrown out against the friction rim, the shoe acts as a wedge, increasing the friction of the two surfaces in proportion as the load is increased. Each shifter arm is provided with an anti-friction roll running in the inclined slots in the shifter sleeve. These inclined slots terminate at both ends in straight slots parallel with the shaft, and serve to lock the shifter arms and prevent when running, all tendency to throw in or out. This clutch is positive in action, and it is stated to be very powerful in grip, and perfectly balanced. It does not throw out oil when running.

Process of Manufacturing Carbon Filaments.

From the time when the incandescent light first became an acknowledged rival of gas, lamp manufacturers have been experimenting with the object of improving the filament. Among those who have been endeavoring to bring about good results in this particular branch of lamp manufacture may be mentioned W. M. B. Keen and W. T. Haarmann of New York. These gentlemen have recently invented a process by which they claim to be able to produce a filament, strong, elastic and durable, and especially of very dense structure.

The first step in the manufacture consists in mixing together the following-named substances or their equivalent: Hops, glue or gum-arabic, saccharine matter, such as glucose, sugar, or honey, and water. The substances should be so mixed as to produce a viscous liquid slightly denser than ordinary molasses. To this end the proportion of water should be about twenty per cent., while the proportion for saccharine matter, hops, and glue are respectively thirty-five per cent., twenty per cent., and twenty-five per cent. The mixture is boiled for about one-half an hour for two purposes—namely, to form a more intimate mixture and to thicken it to the desired degree, which is such that the mixture is in that condition which may be said to be half-way between liquid and solid. Ligatures of fiber, such as silk, cellulose in the form, for instance, of cotton, linen, grass, woody fiber, the skin of fruit, such as orange peel, rhubarb, or, in fact, any carbonizable ligature of porous material, are allowed to remain in the liquid mixture for two or three hours, so as to become saturated with it. In order that the saturation may be complete, it is considered preferable to put the ligatures in the liquid during the ebullition, because at that time the liquid is thinner than when it cools, and because the thickening of the liquid in the pores is an advantage. From the time that the mixture is made until the ligatures are carbonized internal reactions occur similar to those in the pro-

duction of beer. The treated ligatures are dried and then carbonized by any well-known process. For instance, they may be wound upon carbon forms and heated gradually to an incandescent temperature out of contact with air.

The carbons produced by this process are claimed to be highly superior to those which would be obtained by carbonizing the ligatures without saturating them, as described.

An American Electric Light Station in London.

The Sardinia street station of the Metropolitan Electric Supply, London, is of peculiar interest to Americans inasmuch as the apparatus installed is entirely of American manufacture. The machinery was installed in accordance with the designs of the Westinghouse Electric & Manufacturing company of Pittsburg, Pa., under the supervision of the English department. A sectional view of the station is shown in the engraving. There are two entrances to the building; one leads to the offices; the other is used by coal wagons, which pass into a large shed from which the coal is dumped by means of a chute into a cellar large enough to contain 500 tons. It is seen by the cut that the boiler house has a separate roof, and that the floor is about nine feet below the level of the street.

The generating plant consists of twelve Babcock-Wilcox boilers, seven of which are placed along one side of the boiler room, and five along the other. Each is of 210 indicated horse power at the makers' usual rating of 20 pounds of steam per horse power per hour. All supply steam is at 150 pounds' pressure per square inch. Each boiler is provided with a duplicate set of feed pipes, and the blow-off pipes are all led away to a tank under the floor level. Another tank is used for the condensed water from the engine cylinders; and both are provided with vapor pipes. The tank under the floor is below the level of the common sewer, and a Worthington pump is used to raise the water into a third tank placed at such a level that it drains itself into the sewer. The pump is provided with a three-way cock, so that either tank can be emptied as desired. Drain pipes for clearing the water of condensation out of the steam pipes in the boiler house and engine room are collected into a McDougall separator at each end of the boiler house.

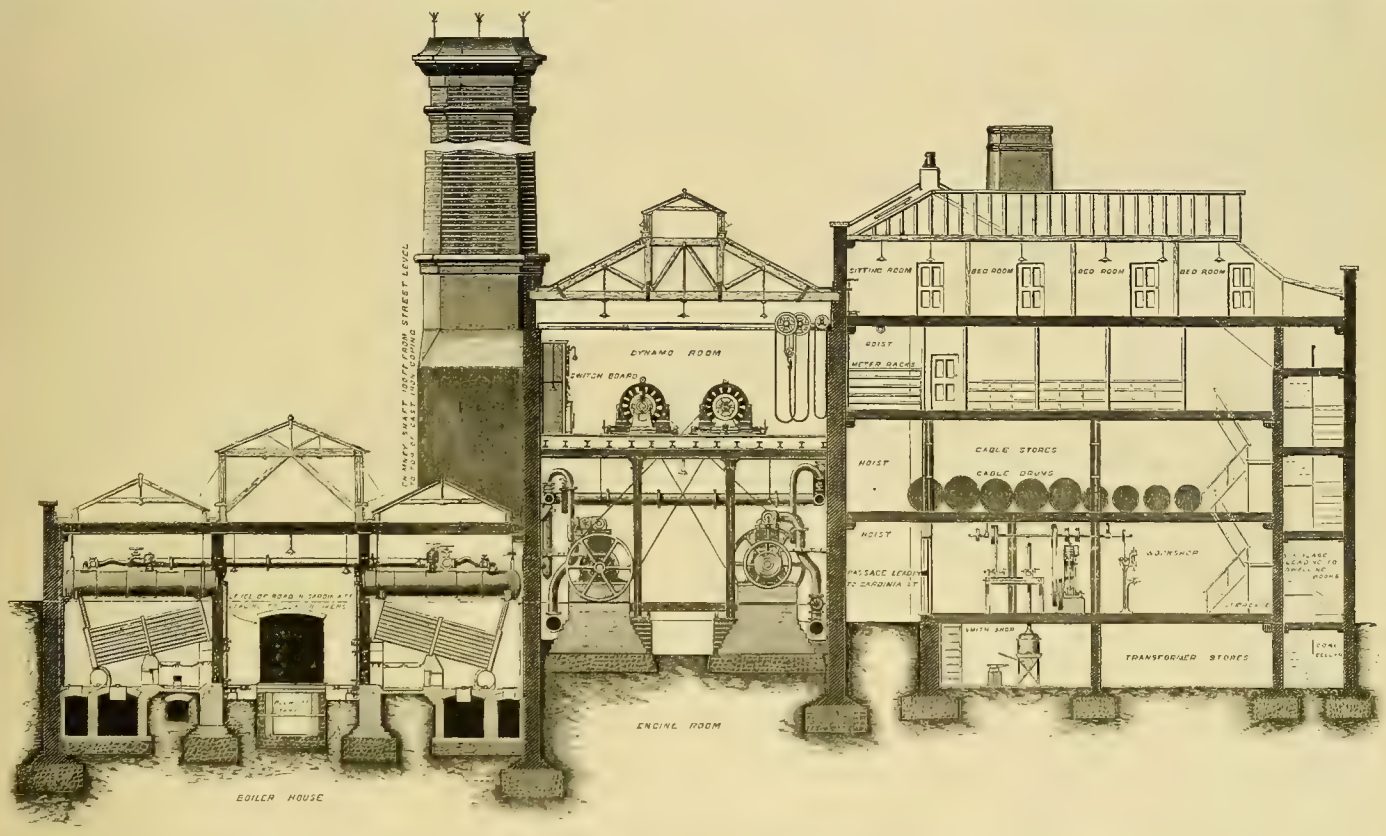
The feed pipes are placed underground, and the steam pipes are overhead; and it will be seen that the latter are at a lower level in the boiler house than in the engine room. There is ample room between the two rows of boilers for stoking, and a track of rails is laid the whole length, along which the coal is brought from the cellar in trucks. Three Babcock-Wilcox feed-water heaters are used, and the exhaust steam from the engines passes down under the floor and up to the heaters, of which two only are in use at one time; the third is held in reserve. Any heater can be shut off without affecting the others, and each is supplied with a bye-pass, so that the exhaust can be passed direct to the chimney if required, and the feed-water can also be drawn direct from the mains. The feed-water is supplied to the heaters by three Worthington pumps. The boiler house is lighted by two Sunbeam lamps, and a lamp of 16-candle power is hung over each gauge glass, and for these a special transformer is fixed upon the wall.

From the boiler house the engine room is reached by ascending a staircase, and the engines, all of which were built in the United States by the Westinghouse company, are arranged in two rows, leaving a wide passage down the center. The engines are mounted upon a brick and cement foundation, which itself rests on a layer of sheet lead, which forms the covering of the actual concrete foundation. The foundations are kept clear of the walls of the building in order to avoid effects of vibration.

There are five engines, each indicating 250-horse power with high and low-pressure cylinders, respectively 14 inches and 24 inches in diameter, with a stroke of 14 inches, and the heavy fly-wheel, which acts also as the driving pulley, is 90 inch diameter. Five other engines each indicate 320-horse power, and have cylinders 16 inch and 27 inch diameter, with a 16 inch stroke. In these cases the fly wheel is 110 inch diameter, and the belt which runs upon it is 20 inches wide. Each of these ten engines drives a Westinghouse alternator upon the floor above. There are also three engines for driving the exciters, and these indicate 90-horse power each, and have cylinders 10 inch and 18 inch diameter by 10 inch stroke, and run at a speed of 320 revolutions per minute. Each has a fly-wheel 5 feet in diameter, upon which runs a double belt 14 inches wide. Belts were made by the Charles Munson Belting company, Chicago.

The steam pipes in the engine room are of steel, 12 inch diameter, with wrought iron flange joints; the steam pipe to each engine is of copper, bent at the top to a semicircle. The main steam pipes, supplied by the Babcock-Wilcox company, are arranged upon a "ring" system, specially designed by Mr. Rosenthal of the company. They are carried by slings from the ceiling, and the steam cocks are so arranged that in case of a breakdown at any one point only one engine would be stopped, for the steam could still traverse both sections of the ring up to the last stopcock before the damaged portion. Each of the main steam valves is provided with a bye-pass, so as to allow the main steam pipes to be filled with steam and heated up before opening the main valve itself. In this way the large initial condensation is easily cleared away by the drainage system before opening the main valves. When the steam pipes have to turn the angle of the engine room, a copper bend is used. A Westinghouse air pump, similar to those used upon locomotives for working the brake, is placed against the wall in the engine house, and the delivery pipes are led away to the dynamo room, and the air is used to clean the armatures of the dynamos and for general purposes.

An oil pump driven by a small Worthington engine lifts the oil into two storage tanks upon the beams in the roof of the dynamo room, from which the machines and engines are lubricated thus avoiding all necessity for the use of oil cans. The Metropolitan Electric Supply company controls six electric stations in London. Two of them are not yet in operation. The cut is reproduced from the London *Engineer*.



AN AMERICAN ELECTRIC LIGHT STATION IN LONDON.

Electric Lights in the Ball Room.

The first annual ball of the Massachusetts Electrical Engineers' and Mechanics' association took place in Boston on the evening of January 28. The ball room was brilliantly illuminated, and the effects were most artistic. Over the platform there was a blaze of red, white and blue lights, out of which, without much trouble, one could pick the letters forming the inscription: "Welcome, M. E E. & M. A." Suspended above the center of the hall was a kite, the outlines of which were depicted in electric lights. The design was intended to represent Dr. Franklin's kite. To place the identity of the kite beyond a doubt the decorator had worked within the outlines of the figure a key, also made of electric lights. The tail of the kite was made of twisted bunting, with electric lights strung along it. From the center piece to the four corners of the ceiling were lines of bunting, with a colored light peeping out every now and then, and a circle of lamps surrounded the clock. There was also an arc light, with screens of several different colors, which cast a fascinating and perpetually changing glamour upon the whirling dancers.

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W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - } Associate Editors.
J. B. O'HARA, - - - - - - - - - - }
F. L. PERRY, - - - - - - - - - - }
A. C. DURBOROW, JR., - - - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE gas companies of Chicago will not stop the leakage from their pipes, so the city authorities have concluded to protect citizens at all hazards, and with this object in view are preparing plans by which the city conduits may be relieved of the dangerous gas.

IT has been decided by the World's Fair authorities to locate the general electrical building at Jackson park. The structure, in accordance with the present plans, will be 750 feet long by 350 feet wide. The available floor space will be about five acres, not including the galleries.

A CELEBRATION which should be of more than ordinary interest will take place at the convention of the National Electric Light association at Providence, February 17th, 18th and 19th. It is proposed to devote one of the sessions to commemorating the completion of the first decennial of the commercial use of electricity for light and power. An effort will be made to secure a large representation of pioneers in the electrical field, who will be called upon to relate reminiscences. The celebration, if the officers of the association meet with the co-operation which they should receive, will be highly interesting, and will form one of the most important features of the convention.

THE Sardinia street electric light station in London, which is described and illustrated in this issue, is a plant of more than ordinary interest to Americans. The dynamos, engines, boilers and even the belts were manufactured in the United States. The equipment of an English station with American machinery is a compliment to our manufacturers far more striking and far more satisfactory than any verbal recognition.

CHICAGO has an air ship and it flies, but it has not made an appearance outside the Exposition building. As yet the creation might be likened unto an hothouse plant, in that it has never felt the warmth of the sun or experienced the effect of a twenty-mile-an-hour midwinter breeze. An oblong bag about sixteen feet long, containing gas; a two-bladed propeller at the front end; a small electric motor in the "car" driving the propeller by cords; a rudder—these constitute Chicago's great air ship. The reader will doubtless experience some curiosity as to how the little motor obtains current. It may, perhaps, be well therefore to state that as an ordinary storage battery, to put it mildly, is a weighty mechanism, the inventor has deemed it best to leave the cells on the ground, and feed the current to the motor on the ship through a cable. We must not be critical, though; the ship is doubtless doing all it was ever intended to do, and as a curiosity it will probably be the means of relieving the public of many spare quarters.

THE last meeting of the American Institute of Electrical Engineers was devoted exclusively to a discussion of the proposed unit of self-induction, the henry. An abstract of the discussion appears elsewhere in this issue. It will be remembered that at a previous meeting the committee appointed to fix the value presented its report in which it recommended that the practical unit of 10^9 absolute units of inductance be retained. The discussion developed the fact that not all the members of the institute shared the views of the committee. The definition of the unit as a length expressed in centimeters was attacked, and it was asserted that it should be defined in terms of the counter electromotive force in "legal" or "practical" units, as might be decided. It was also questioned whether Prof. Henry was actually the discoverer of self-induction. It was also thought that action by the institute was unwise, inasmuch as it lacked the power to induce the fraternity to employ the new unit. The report was finally adopted. A great many points were brought out which were of more than ordinary interest; the entire discussion, in fact, is well worthy a perusal.

THE delay in organizing the electrical department of the world's fair has caused much anxiety in the minds of those most deeply interested in the success of this branch. It was expected that the initial steps would be taken a month ago and the department would be thoroughly organized by this time, but the first step in this direction has yet to be taken. There is no good reason why the electrical section was not opened with the beginning of the new year. It has been repeatedly pointed out that there will be no necessity for appointing an expensive staff of experts and clerks for some time to come, but there should be some one empowered to look after the interests of this important department. At the meeting of the commissioners last Saturday Director-General Davis said he wanted to organize six departments at once, and the question of appropriating sufficient funds for the expenses of these departments was referred to a committee. It is understood that one of the departments will be the electrical section and that the director-general will make the appointment of the chief electrician as soon as he is assured of the appropriation. The necessity of taking prompt action in this matter should be fully impressed upon the commissioners. The success of this department, like all others, will depend largely on the confidence which the action of the managers inspires in manufacturers and inventors. In order to arouse universal interest in this branch the directors must show that they understand what will be required and display a readiness to meet all demands.

THAT carbon dioxide may be employed as a fire extinguisher is well known; but the idea of its special application to telephone exchange conflagrations is, perhaps, something of a novelty. In another column is presented a description of an apparatus designed for service in case of a switch-board fire. The mechanism of the extinguisher is simple. A tank in which the gas is quickly manufactured on demand, and a hose by which the latter may be applied, constitute the equipment. By the use of such an apparatus the water hose may be left idle, and the fire extinguished, it is stated, by the gas alone. Anyone who has ever inspected the back of a switch-board in one of our large city exchanges will appreciate what a great amount of damage a little water might do. The advantages of an efficient extinguisher in which water is not employed will, therefore, be apparent.

THE terrible explosion at the mammoth colliery at Greensburg, Pa., last week which caused the death of over 100 miners, was precipitated in all probability by the use of unguarded lamps. The mine was supposed to be entirely free from gas, and for this reason was regarded as one of the safest in the coal district. The miners, therefore, did not use safety lamps. No one survived to relate any of the circumstances of the explosion, but it is supposed that a miner struck an unexpected pocket of gas and his naked lamp precipitated the fearful calamity. The fact that the explosion was due to the use of unprotected lights has led to a discussion of the present unsafe methods of illumination. It is urged that if the electric light were generally employed the probability of such catastrophes would be exceedingly remote. The legislature of Pennsylvania has appointed a commission to inquire into the horror, and it is not unlikely that laws relating to the use of open lamps will be adopted. It is stated that miners are not inclined to use safety lamps unless they are convinced there is actual danger. They prefer to use an open lamp, as it gives better illumination. But the severest code of mining laws will not protect miners if they are reckless or ignorant. It is suggested in view of these considerations that the illumination should be such that all the lights will be controlled by a responsible operator entirely apart from the miners; in other words that electric light should be adopted. Unquestionably the present careless, dangerous methods should be discarded and a modern system substituted. As the matter is one of vast importance the following extract from the Philadelphia *Times* is presented as bearing on the question. Speaking of the employment of electric light it says: "The experiment has been made in several instances and so far no explosions have occurred in mines thus lighted. Electricity was first introduced in the Shawnee mines of Hocking Valley nearly two years ago. This system of lighting is now in vogue in a score of coal mines in this country and seems to have become almost universal in the iron and copper regions of Lake Superior. While it is not impossible that explosions might occur in mines lighted solely by electricity from imperfect insulation or the breaking of incandescent lamps, yet the fact that no accidents of this kind have occurred in the mines in which the experiment has been tried is strongly in its favor. Apart from the fact that insulated wires and incandescent lamps afford no point of contact between the explosive gases and the fatal spark that renders them destructive to human life, the placing of the entire business of lighting the mines in charge of a single agency independent and apart from the miners themselves would be a great advantage. Those who are interesting themselves in legislation for the protection of miners will do well to give the subject of doing away with all lights in the hand of the miners themselves serious consideration."

Chicago Electric Club and the World's Fair.

The Chicago Electric club has for some time had the matter of appointing a committee on the World's Fair under consideration, and a meeting of the board of managers was called for January 19 to take action on the matter, but owing to the absence of several of the managers from town, the meeting was postponed until February 2. In the meantime, however, a request came from Consulting Engineer Gottleib of the World's Columbian Exposition, that a committee of the club be appointed as the construction department desired the benefit of advice and suggestions immediately. A special meeting of the board of managers was, therefore, called for January 30, and prompt action was taken. Two committees were appointed, the first being a large and representative committee as originally intended by the managers. The second committee, which was appointed at the suggestion of the consulting engineer, was also named at this meeting. The first committee was composed of the following named gentlemen: B. E. Sunny, chairman, F. S. Terry, W. A. Kreidler, C. H. Wilmerding, F. S. Gorton, F. W. Cushing, F. E. Degenhardt, W. J. Buckley, C. H. Wilson, Alexander Kempt, C. E. Gregory, W. J. Chalmers, M. A. Knapp, C. A. Brown, J. P. Barrett, F. B. Badt. This committee will be permanent, and from its members will be appointed from time to time such smaller committees as are needed to do special work.

The committee to consult with Engineer Gottlieb is composed of the following members: B. E. Sunny, chairman, F. S. Terry, W. A. Kreidler, C. H. Wilmerding, F. S. Gorton, F. W. Cushing, F. E. Degenhardt, F. B. Badt. This latter committee met with Engineer Gottlieb in the office of Chief of Construction Burnham, for the first time, on Tuesday last.

It is the understanding that the electrical commissioner shall be an active member of any and all of the smaller committees which may be appointed from time to time from the large general World's Fair committee to do special work, providing of course he is a member of the club.

Opposed to Telephone Wires.

An interesting case has been begun in New York City as a result of the recent storm. Judge Ingraham of the Supreme Court, upon the application of Mary K. Sprague of 182 West End avenue, has granted an injunction restraining the Metropolitan Telephone & Telegraph company from erecting or maintaining poles or wires in Seventy-third street, between West End avenue and the Boulevard, and on West End avenue, between Seventy-third and Seventy-fourth streets. Mrs. Sprague is the wife of Frank J. Sprague, formerly vice-president of the Sprague Electric Railway & Motor company, consulting engineer of the Edison General Electric company. Mr. Sprague says that the poles of the defendant are 20 inches in diameter at the base, and 70 feet high, and have 17 cross arms, each of which carries ten wires.

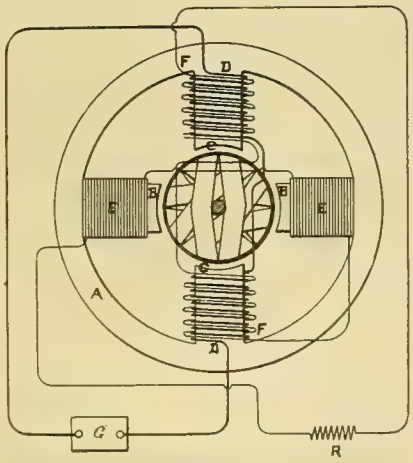
These are serious obstructions, he says, to light and air, and one of them stands in front of his wife's house on the corner of West End avenue and Seventy-third street. He is afraid it will fall, as it was cracked and warped by the recent storm, which leveled to the ground all of the poles on the street, from the Boulevard to West End avenue. One of these poles damaged the residence of D. S. Lamont, and another fell across the stoop of W. L. Trenholm. Still another injured the Rutgers Church. The poles which remain are being propped up, and the company proposes to use them again. Mrs. Sprague objects, contending that the wires should be put underground.

Improved Tesla Alternating Current Motor.

Among the various forms of alternating current motors invented by Nikola Tesla is one which is constructed as follows: A field core is built with, say, four poles, between which is mounted an armature that is generally wound with closed coils. On two of the opposite poles of the field primary coils are wound, which are connected up in the main circuit. On the same cores are also wound secondary coils, which are closed through coils on the other pair of poles. In this motor when an alternating current is caused to pass through the primary coils it energizes directly one set of poles and induces currents in the secondary coils, which act to energize the other poles; but the phases of the current in the secondary coils may differ in time from those of the primary current, and hence a rotation or shifting of the poles is effected that imparts rotation to the motor.

In the motors constructed in accordance with this principle two energizing circuits are brought into inductive relation in the motor itself—that is to say, the secondary currents which energize one set of the field-cores are induced in the motor itself, and the employment of an external induction device is thus avoided. The operation of these motors, however, is dependent upon the existence of a certain difference of phase between the currents in the primary and secondary coils. To obtain a difference of phase or lag that is suited to working conditions is the specific object of the construction employed in the present case.

Referring to the cut let *A* designate the field magnet of a motor, built up of sections or plates. *B C* are polar projections upon which the coils are wound. Upon one pair of these poles, as *C*, are wound primary coils *D*, which are directly connected to the circuit of an alternating-current generator *G*. On the same poles are also wound secondary coils *F* which are connected with other coils *E*, which surround the poles *BB*. The current in both primary and secondary coils in such a motor will lag behind



IMPROVED TESLA ALTERNATING CURRENT MOTOR.

the impressed electromotive force; but to secure a proper difference in phase between the primary and secondary currents themselves the resistance of the circuit of the secondary is increased and its self-induction is reduced as much as practicable. This action is obtained by using for the secondary circuit, particularly in the coils *E*, wire of comparatively small diameter and having but few turns around the cores; or some conductor of higher specific resistance such as German silver is used. Thus the self-induction of the secondary is kept down and its resistance increased with the result of decreasing the lag between the impressed electromotive force and the current in the primary coils, and increasing the difference of phase between the primary and secondary currents.

Rapid Transit for New York.

Never before in the history of New York was the prospect for rapid transit so bright as at the present time. The advocates of the numerous projects under consideration and the people generally were encouraged by the announcement that the Stewart bill had passed the third reading in the senate at Albany, and was immediately approved by the assembly and governor. The remarkable spectacle of the whole thirty-two senators agreeing upon a vote on the final passage of the bill, was presented.

Public meetings have been held to advocate immediate steps toward securing improved service. A memorial to the legislature was adopted by citizens of Harlem in which their grievances were noted and their demands concisely expressed. The memorial says: "The temper of the people of New York is aroused upon this subject, and they will not tolerate further delay. They require: First, That all the existing modes of rapid transit be improved in every feasible way, so that such immediate and temporary relief as is possible, may be had. They further require that your honorable body shall enact such legislation as may be needed."

As a result of the evening's enthusiasm a resolution was offered and adopted providing for the formation of a Rapid Transit League, to be composed of "citizens from every part of the city, irrespective of party affiliations, for the common benefit of the community." Jordan L. Mott was named as president and Charles H. Cronan secretary of the league, and all citizens were invited to join and co-operate. The agitation will be kept up until rapid transit in fact as well as in name is secured.

The Henning Rapid Transit company, New York has been incorporated, with a capital of $140,000. Its scheme for rapid transit is an underground one, with a route to begin near the Hamilton Ferry, Brooklyn, and proceed to the East River; thence by tunnel under the river and underground to the city to the southwestern corner of Westchester Township, and then to intersect One Hundred and Fifty-fifth street and Eighth avenue by means of a branch road. The road as projected will be about fourteen miles long. The directors are Benjamin S. Henning, Grinnell Burt, Richard Muser, William E. Bond and Otto Andreæ, Jr.

The Chemistry of Electrolysis.[1]

By Wm. H Dopp.

To-night we are to consider the subject of the chemistry of electrolysis. In regard to the treatment of the subject, I will say that at a meeting of the executive committee of the society, it was decided that some at least of the papers for discussion should be of an elementary character, and I promised that what I had to say on the subject of the chemistry of electrolysis would be of that elementary nature. The subject has one advantage, in that some of the greatest lights of modern science have devoted a great deal of time and attention to it; chief among them Michael Faraday, Sir Humphrey Davy, Sir Wm. Thomson, and others have given this subject such thorough study, I am sure you will all absolve me if I use the language of these men, because there is really nothing original to be said on the subject.

In the first place, it will be well for us to get a clear idea as to what is meant by a *chemical change*. I take some iron and some sulphur and mix them, and produce a result looking different from either. As the sulphur is decidedly yellow, and iron is a sort of bluish gray, this mixture is a totally different article, in appearance at any rate. Yet that we have nothing but the mixture of iron filings and sulphur, is shown by this very simple experiment; we take off the iron filings by means of a magnet, and by careful manipulation it is possible to separate the sulphur and the iron completely. Or we may take a little of this mixture and dissolve out the sulphur. I will use for this purpose the ordinary solvent used by shoemakers in dissolving gutta percha,—bisulphide of carbon, which is a solvent of sulphur. You will see the iron filings gathering in the lower part of the test tube here, and the murky solution above, showing the iron filings separated. We can go to work in a slightly different manner, and make the separation by another method. I have here nothing more than a little alcohol, and its effect upon the mixture, as you will observe, is that we get the iron filings at the bottom and the sulphur in suspension. Sulphur is not dissolved by alcohol, and this is a purely physical separation. I might just as well have taken a quantity of water, only water is not quite so pleasant to handle as alcohol, since the iron will begin to rust. We might take the sulphur and iron mixture and separate them by centrifugal force, or by simply an air blast, the lighter particles being driven on while the heavier particles of iron would drop. Now, this is nothing more nor less than a simple physical mixture.

I will now try to show you the difference between a physical mixture and a chemical combination. Into the crucible which I have here, I will pour some of this mixture of iron and sulphur. As soon as it gets hot we shall get a combination, and it will be totally different from what we have been getting in the simple mixture,—a result which is neither iron nor sulphur, but a combination of the two, ordinary sulphide of iron, or as it is known in mineralogy, iron pyrites. It has also the fanciful name of "fool's gold," because it very frequently crystallizes in a yellow crystal often mistaken by the ignorant for gold. This substance is totally different; from the mixture of its constituents no amount of action of the magnet will make any difference in it; bisulphide of carbon has no effect upon it; nor would there be any effect produced if I should, as I did with the mixture of iron filings and sulphur, try to separate them by simply mixing them with alcohol and allowing the heavier particles to settle first.

Generally speaking, in physics, we deal with single substances, and their relations to the different forces of nature or different forms of energy. In chemistry we deal with the reaction or interaction of one substance upon another. That is a general statement, however, and must be more or less modified. The main facts of chemistry you must take on trust to night. The chief facts and doctrines of chemistry, I will have to allude to, however, so far as they relate to some of the definitions that we use in chemical science. And let me remark here that all modern science is founded primarily upon clear and precise definition, and upon close and accurate observation and experiment; these two things are absolutely necessary. Therefore we must be careful to make a clear, accurate and precise definition of every term that we use. In the first place, we use the term *element*, and by that term in chemistry, we mean any substance which can not with our present knowledge, be reduced to any simpler form. There are substances to-day regarded as elements that may possibly be compounds,—notably the larger portion of the atmosphere, the gas nitrogen. Many chemists believe that nitrogen is actually a compound, and not an element. We have so far, however, been unable to reduce it to anything simpler, and therefore we still regard it as an element.

Now, in regard to the chief doctrines of chemistry, I

[1] A lecture before the Buffalo Electrical Society, Jan. 15, 1891.

shall allude to only one or two We have also the terms theory, hypothesis and speculation. A scientific speculation pays no particular regard to facts and experiments. It simply is a supposition of what might be. It may not be supported by any facts. We can say, for instance, that the idea that all substances are at bottom one, is a scientific speculation; though we have no facts, really, to base such a statement or idea upon. When we obtain a certain amount of knowledge, acquired by experiment and observation, we may formulate a statement as to what we suppose to be the relationship of these facts, and consider this statement a working hypothesis, or working supposition. Then we will try to determine whether other facts will correspond with this hypothesis or supposition. After this hypothesis has been satisfied by a great many facts—and especially if we are enabled to predict certain facts which are not yet known, and then discover these facts by experiment,—we call it a theory When we get one stage farther, when we feel absolutely certain that we are correct as far as we go, then we call it a doctrine.

Now then, the chief doctrine of chemistry is in the first place, that all substances are composed of minute particles, which in themselves are indivisible. These particles are known as atoms. Furthermore, each atom has a definite weight. As to size we know nothing; its size may be variable Besides having a definite weight, we know also that the atoms always combine in a certain definite proportion, though some of these proportions are not as yet quite accurately determined. For instance, if you look over your text books on chemistry, you will find that oxygen is given as having a combining or atomic weight of 15.96, whereas some ten or twenty years ago it was always given as 16. This change is due to nothing more nor less than the fact that we have had more accurate experiments since the original determination; it does not vitiate the statement at all that oxygen will always combine in a certain definite proportion with every other substance. Further, if it does not combine in this simple proportion of 16—I shall use round numbers—it will combine in some even multiple of 16, say 32, or possibly 64 or 48; but it never combines in half of 16. In other words, if we have a compound in which the ratio of the two elements is 1 to 1½, we know that it is not possible to exist except in that ratio, but must exist in the ratio of 2 to 3. For instance we have a compound known as oxide of iron, 2 particles of iron and 3 of oxygen $Fe_2 O_3$ or the sesqui oxide, as it is called. There we know that there must be at least two atoms of iron and three of oxygen. As it may seem to you that I am making a pretty strong statement when I say we *know*, it may be proper for me to say a word as to the character of the evidence on which we make these statements. It is exactly of the same nature as would be the case if you should go into your pantry at home and find that some of the supplies had disappeared. We will suppose you find certain marks very evidently the footprints of mice You would not hesitate a moment in attributing your loss to mice. Supposing, however, you did not find any footprints. Then you would have to make an experiment. You perhaps would put some bait there and watch. Next day, perhaps, you will find your footprints; then you would put a trap perhaps, and might catch your mouse. Now that is the same evidence as is used in all scientific investigation, only in the latter case we must sift out the errors, and repeat experiment after experiment, until every fact is substantiated by thousands or perhaps tens of thousands of separate experiments.

Thus, we take, as I have said, for granted, that all substances are composed of atoms, that these atoms combine in certain definite proportions, and that when any one substance combines in more than one combination, that combination contains it always in some simple multiple of its original combining proportion.

There is another fact in chemistry which I must mention, and that is the doctrine of chemical equivalence, or valency. We take as our unit, the gas hydrogen, one of the constituents of water, and as far as our knowledge extends the lightest substance. An atom of hydrogen weighs 1; and hydrogen being taken as 1, oxygen will weigh 16. But one atom of hydrogen is not sufficient to saturate one of oxygen; it takes two atoms of hydrogen to saturate one of oxygen; it takes three atoms of hydrogen to saturate one of nitrogen. In fact, we have some elements which would represent six atoms of hydrogen. Therefore, we say the equivalence or valency of an element is 1, 2, 3, 4, 5 or 6, according to the circumstances. Again oxygen has an equivalence or valency of 2, and is termed a dyad element. I shall not speak of any further ones, as I simply want to call your attention to the principle, because it bears directly upon the theory of chemical decomposition by the electric current. We have, then, thus far, seen the distinction between a simple mixture and a compound.

Next let us see if we can find a few facts in regard to chemical action. We have so far had simply a combination Now I want to show you a decomposition produced simply by the action of heat. I have here a solution of platinum, a compound of platinum chlorine, which is readily decomposed by heat. Under the effect of the heat I think you can see the little spicules of metal. In this experiment platinum is usually deposited, not as a coherent metal, but as a black deposit; and in the electrical decomposition of the solution, it is also usually deposited as a fine powder, or platinum black. We have seen from this experiment that it is possible to produce chemical decomposition by the action of heat. In all chemical changes—in all chemical action—there is a redistribution of energy, and that energy is sometimes absorbed and sometimes set free. Energy is usually set free in chemical combinations, and generally is absorbed in chemical decompositions. To effect this decomposition of the platinum I required heat, in this flame the chemical action sets the energy free in the form of heat There are three forms in which the liberation of energy appears. Heat, light and electricity.

I have here a very hot flame, and here, a substance which those of you who are interested in photography are acquainted with. It is nothing but a little powder of magnesium, a substance which will probably liberate a greater amount of light in proportion to the heat than any other. We have, then, secondly by chemical action the liberation of light Third, we have energy liberated as in this battery here; you have just seen chemical decomposition by heat; and in the photographic film light is the active agent. We shall next proceed to chemical decomposition by electricity, which is the principal subject of to-night's discussion. All that I have said thus far has been preliminary to this subject, in order that we might have a better understanding of it. In electrical decomposition, we find that certain elements always appear at a certain pole of the battery, or at a certain electrode, as Michael Faraday called it. He gave the term "ions," or travelers, to the elements, and the term "electrodes" to the terminals, or what were formerly called "poles" of the generator. He called the terminal by which the current entered, the "anode;" the one by which it passed out, the "cathode." At the cathode, metals all appear; at the anode, the non-metals always appear. Hydrogen gas, which is considered by all chemists as a metal, also appears at the cathode. Sir Humphry Davy startled the world by an experiment which I shall try to repeat. I have in this vessel a solution of the common sulphate of soda. Here I have nothing but water; and in this vessel there is nothing but water. They are simply tinted by a little tincture of litmus, which has the peculiar property of being changed by the action of an acid to a red, and by the action of an alkali to a blue. Now, having turned on the electric current, you will notice that those at the end are beginning to change in tint, while the center one does not change. The interesting fact in this experiment is that the central substance is not changed. The acid appears in the third, having passed from the first, through the center one, without showing any effect in the latter. Under the action of the current, then, the acid passing in one direction, and the alkali in the other, there is no effect on the one intervening, so far as the acid properties are concerned; in other words, the effect is masked. That experiment created quite a sensation when first exhibited by Sir Humphry Davy. The explanation is, however, that there must be a series of particles of the same nature from one end to the other: otherwise electrical decomposition is impossible, There is no doubt that these pieces of asbestos which you see running across carry quite a little of the sulphate of soda into the second cup, and a little over into the third and we must have a complete series of molecules or particles of sulphate of soda from one side to the other, otherwise we could not produce any action whatever. This, then, is the principle of the action of the current, the electro-transfer of elements. Those elements always travel in opposite directions with reference to each other, and always in the same direction with reference to the direction of the current, the metal and hydrogen always appearing at the cathode; the non-metal, or acid, always appearing at the anode. Michael Faraday investigated perhaps more thoroughly than any other experimenter the action of the electric current in chemical decomposition; and in fact, most of the experiments that we have, standard experiments, are really due to him. He established two laws of electro-chemical action. First that of definite electro chemical action. In other words, he proved beyond a question that a current of a certain strength will always produce a certain amount of decomposition, no more, no less, in a given time. A certain amount of hydrogen can be set free by a current of a certain strength in one minute; a certain amount of oxygen can be set free, a certain amount of metal can be deposited, so much, and no more. Moreover, he showed, secondly, that if you pass a current consecutively through three or four more solutions, each element is deposited only in direct proportion to its combining or atomic weight. But elements which represent two atoms of hydrogen are not deposited in their full combining weight, but just one-half their combined weight. For instance, for every one grain of hydrogen that is liberated in decomposition, only eight grains of oxygen are liberated, about 32 grains of copper, and about 35½ grains of chlorine gas. Sulphur, if liberated, is liberated also only one-half its combining weight, it being again an element which represents two atoms of hydrogen.

I have here some pieces of apparatus which I think will show what I wish to illustrate. I have in this voltameter ordinary muriatic acid; in the other I have slightly acidulated water. Under the action of the current which I apply you will notice an accumulation of gas The object of this experiment is to prove that under all circumstances the same amount of the same element is liberated when we have the same strength of current acting for the same length of time. Secondly, that there is this electro-chemical equivalent of which I spoke. There is another fact, which our text books generally ignore; that is, that it takes a certain electromotive force to produce decomposition. One element of Daniell or one cup of gravity will not decompose water. We must have at least two cells of Daniell battery or gravity battery in order to decompose water. The reason for this is well known, and was probably first thoroughly investigated by Joule. To recapitulate, the elements of the chemistry or electrolysis are:

1st. That under all circumstances, each element appears at a certain one of the electrodes, the metals, and hydrogen, at the cathode, the non-metals, acids, etc., at the anode.

2d. The elements travel through the intervening space between the electrodes, in opposite directions, and do not leave any record of their presence *as elements* in that transfer; the electro-transfer of the elements is imperceptible in the body of the liquid, as you have seen from this experiment of Sir Humphrey Davy.

3d We have a definite electro-chemical action from a current of a definite strength in a given time.

4th. We have electro-chemical equivalents.

5th. It requires a certain minimum electromotive force to produce decomposition.

Electricity in Mining.[1]

With the development of the electrical system for the transmission of energy, the assistance which is offered in providing cheaper power in mining work was quickly realized by engineers, and within the past two years so many electric power plants have been installed at mines, not only in the United States but also in England and on the Continent, that they have already ceased to be a novelty, as the pages of the *Engineer and Mining Journal* testify. So successful have these plants been that their early promise of effecting a revolution in the mining industry in many places seems not unlikely to be fulfilled.

Already, it is stated, in the colleries where electric tramways and the very efficient electric coal cutters have been introduced, the cost of mining has been very materially reduced, while in many metal mines electrically driven hoisting engines, located far underground, have made perfectly easy much work hitherto attended with difficulty and great expense.

Aside from those in the coal mines, the mining plants so far set up have been in a measure incomplete, for many difficulties peculiar to mine work could be studied and overcome only in actual practice. The driving of pumps underground was one of the early applications of electric motors, but the invention of a practical electrically driven percussion drill was long an unsolved problem.

In the electrical system of power transmission the advantages which make it peculiarly valuable in mining operations, and which are afforded by no other system, are found in its practically unlimited flexibility and the facility with which it may be divided; while a utilization of as much as 70 to 80 per cent. of the motive power has been attained, and in some cases this is greater than that of any other method of transmission. In such cases as shops, where there are many machines doing intermittent work, the fact has been well established that it is more economical to use a separate electric motor for each machine, and have all these take their power from a central dynamo driven by a steam engine, than to drive lines of shafting direct from the steam engine, as has heretofore been the universal custom.

For comparatively short distances in direct lines the wire rope transmission is undoubtedly the more economical, but it is only under favorable conditions that it is applicable. As an agent for the transmission of power underground electricity is unrivaled. We have been practically confined, hitherto, for this purpose to steam and compressed air, which are necessarily expensive, and the use of steam is obviously objectionable underground.

It is for two purposes, chiefly, that electricity has most efficiently aided the mining engineer, viz: the long-distance transmission of power above ground, rendering possible the utilization of cheap sources, such as waterfalls or the waste heat from coke ovens, and the short-distance transmission of power underground, superseding steam and even compressed air.

The possibility of bringing all necessary power direct to the mine from one source, perhaps a waterfall several miles away, over a rugged or mountainous country, regardless of weather, by means of copper wires, and using electric motors for operating winding engine, rock breaker, jigs, fans, etc., on the surface and for pumps, diamond or percussion drills, winze hoists, underground haulage, etc., while at the same time illuminating levels and stopes, is certainly an alluring prospect to the miner, and one which it seems probable many will realize before long.

At the present time there are in use electric hoisting engines, rotary and plunger pumps, ventilating fans, locomotives for haulage, coal cutters, coal borers and diamond drills. All these machines are of well known and commonly used types, simply adapted for combination with the electric motor, which replaces the steam engine.

Among recent inventions are the percussion drills and pumps of the electro magnetic reciprocating type, in which the energy is given to a plunger by means of the attraction and repulsion caused by a current flowing alternately through one of a pair of solenoids. These machines have not, as yet, come into general use, nor have they had a thorough trial in practice.

Besides the efficiency and flexibility of the system of electric power transmission, its safety and reliability are important considerations. There are three dangers to be apprehended from the use of large electrical currents in mines; the danger of fire from short circuits, overheating of wires and sparking machines, the danger of shocks received by men at work in the mine, and the danger of failure of apparatus to work properly at critical times. With proper safeguards and careful construction, these dangers may be entirely eliminated; but the history of electric lighting in all its details of cheap and incapable machinery, unscientific and criminally reckless line work, must not be repeated in mining installations, where a failure of any part of the system means so much greater liability of serious accident.

All wires in mines should be insulated in the best possible manner, and should be so arranged as to be readily accessible to inspection and repair. This is even more important in underground workings than upon the surface, as in the former wires are almost certain to be in damp places and frequently subjected to acid waters. It is a temptation, which has been yielded to in some cases, to use old wire ropes as the return cable; but whenever such an uninsulated line is used, the danger of short circuits is considerably increased. All wires should be of ample size and everywhere protected by proper cut-outs, while motors should always be of such size as never to be called upon to perform an excessive amount of work, under which conditions, if properly cared for, sparking is not to be apprehended.

Large amounts of power from remote sources, will necessarily be transmitted at high voltage, but underground no current at greater pressure than 500 volts should at present be permitted, and we notice in many installations a tendency to use no more than 250 volts. With currents

[1] Engineering and Mining Journal.

of no greater potential than these, experts are agreed that there is no danger whatever to human life.

The reliability of electric apparatus has been sufficiently demonstrated. The fact that street railway motors, than which none are subjected to more severe usage, make a daily mileage as great as the railway locomotive, with much less care and attention and so small an expense for repairs, as figures have shown, may be accepted as proof of it.

Neither the electric generator nor the motor is a complicated piece of machinery; and no class of apparatus responds more quickly to sudden demands upon it, or gives quicker indications of being out of order, or is quicker repaired in the event of temporary derangement.

With the present year we look for a great increase in the number of electric mining plants in the coal and metal mines, especially where now wasted waterfalls can be used for motive power.

Inductance and Its Proposed Unit, the Henry.

At the last meeting of the American Institute of Electrical Engineers, January 20, A. E. Kennelly's paper on "Inductance and its Proposed Unit the Henry," and the report of the committee on the proper value of the Henry, were discussed at considerable length. The report of the committee, which appeared in the last number of the WESTERN ELECTRICIAN, was read by Prof. Francis B. Crocker.

In the discussion Prof. Crocker said that there was authority for spelling the plural of the proposed unit "henrys" inasmuch as it was derived from a proper name The definition in terms of other units was to be settled, he said, by scientific usage. It could be defined in terms of the second and ohm, or in terms of the counter-electromotive force and rate of change of current.

DR. CARY T. HUTCHINSON, who opened the discussion, said he did not think there could be any doubt whatsoever as to the approximate value of this unit. It ought to be 10^9 absolute units; but whether it should be exactly that, or only approximate to it, was another question. He said the whole thing hinged on what meaning the committee intend the word "practical" to have. If by the practical unit is meant the unit corresponding to the ohm, and which is an even multiple of the C. G. S. unit; then it would have one value. If, however, by the "practical unit" you mean that value which will fit the ordinary equation of induction, of which Ohm's law is only a special case, the unit would have another value. In other words, the unit of current in the electro-magnetic system is defined absolutely; the legal ohm, or whatever unit of resistance is chosen, is arbitrarily defined, and its relation to the ohm is determined experimentally. The unit of electromotive force is deduced from Ohm's law. Now the unit of induction might be defined as ten to the ninth power C. G. S. units, or it might be defined as that value which will make true the equation

$$rC+L\frac{dC}{dt}=E.$$

The two values will not coincide at all, for the simple reason that the ordinary unit of resistance is not the ohm. It is not what is called the "true ohm," although I think "true ohm" is a misnomer. The Paris Conference in 1889 recommended 10^9 centimeters, and named it "quadrant." The British association adopted both the value and the name. Professors Ayrton and Perry very vigorously maintained that the unit to be used by practical men must have the value which makes that equation of induction true, which would be approximately $.9977\times10^9$. I think the definition in terms of the centimeter is unfortunate, for the reason that its length is purely artificial, and is so only on account of the "suppressed dimension." The definition should be in terms of the phenomenon; that is the counter-electromotive force, expressed in terms to suit the C. G. S. unit "practical" or "legal," as may be decided.

Dr. Hutchinson thought that the designation "Henry" was a rather unfortunate one for a unit in that it was such a common name It was different in this respect from the names of the distinguished men employed in designating other units. He thought Prof. Henry should be honored, and honored greatly, but he did not know that it was strictly true that he was the discoverer of the bare fact of self induction. It had been recently shown that in 1803 Vassali Eandi discovered the increase of the spark on breaking the circuit with increased length of wire. He also thought that the institute was assuming a great deal of authority in settling the matter. He thought that in the determination of a matter in which international consent was essential delegates from foreign societies should act in connection with the institute.

Townsend Wolcott said in the course of his remarks: "In his paper on Inductance and its Proposed Unit, the Henry," Mr. Kennelly remarks: 'It may be well to notice that inductance is only conventionally and perhaps not essentially a length.' He then quotes some remarkable statements of Prof. Rucker on this point, remarkable in showing the amount of misapprehension which exists among scientific men regarding so simple a subject as the theory of the dimensions of physical units.

"Inductance is not a length; there is no room for a perhaps, regarding that question. To be sure the *unit* of inductance has the dimensions of the *unit* of length in the electro-magnetic system of units, but then in the electro-static system it has the dimensions LT. Is there any more intimate association between the electro-magnetic system of units and the actual physical quantities which they represent, than between the electro-static system and the same physical quantities? If not, it behooves some learned professor to cudgel his brain over the question whether inductance is really the reciprocal of an acceleration or whether it is more likely the reciprocal of a velocity (a quantity of the nature of a slowness, as one of said learned gentlemen once remarked), multiplied by a time.' A slowness multiplied by a time must be awfully slow - too slow I fear for this audience, so I will say no more about it.

"If inductance really were a length, not only ought we to be able to measure it by some of the methods of measuring length, but it would be absurd to encumber our nomenclature with a new name for an old unit. We should by all means stick to quadrant, or centimeter as the case might be.

"If Mr. Kennelly's or Prof. Rucker's mind is disturbed by the fact that magnetic permeability, although a physical property of matter, has no dimensions with respect to length, mass and time, I would call their attention to the fact that this is so only in the electro-magnetic system, while in the electro-static system the dimensions are those of the inverse square of a velocity, or if they so prefer, the square of a slowness."

Mr. Wolcott believed that the value of the henry should be 10^9 absolute units. The criticism that the volt was too small he thought very weak. He said, "I have never heard a bridge-builder complain that a foot is too small a unit because he builds bridges several thousand feet long. I have never heard any one complain that the dollar is too small a unit because he can't express his bank balance in less than five or even seven figures. In fact, we already have a larger legal unit, the eagle, but no one uses it."

"In the first place I would suggest that the committee define clearly what the henry is to be the unit of. It is ordinarily called the unit of self-induction, but the term 'self-induction' includes more and less than the quantity which is to be expressed in henrys. It is a general term denoting all the phenomena due to the creation of lines of force in a coil through which a variable current is flowing. Thus we have the e. m. f. due to self-induction, the lag due to self induction, the work due to self-induction, the coefficient of self induction, etc., etc., any one of which the henry might be the unit of, and of only one of them is it the unit; namely the coefficient of self-induction. But the definition of the henry as the unit of the coefficient of self-induction is objectionable for a reason, which though technical, appears just as cogent. A coefficient is a number, a multiplier, and can have no unit except unity. A coefficient is not a quantity that can be measured or weighed, it is simply a ratio. All things considered it appears best to call the henry 'the unit of inductance,' a term suggested I believe by Fleming and used by Mr. Kennelly in his paper. In the next place it would be well to define exactly what this term 'inductance' means, Fleming using the ordinary term L to denote inductance.

"There is another consideration in favor of adopting as the unit of inductance 10^9 the absolute unit, which I have not heard mentioned, and that is the fact that, in equations involving inductance along with other electrical quantities, we may perform directly all the algebraical operations without having to change the value of L.

"There is another consideration bearing on this subject, whose effect it is hard to predict at the present time. That is the variation in the value of the permeability of iron and steel. This variation will cause the values of the henrys obtained by means of the first and third of those three equations to be different. Taking L as the ratio of the electromotive force of self-induction to the time rate of change of the current, we will get for this particular transformer nine henrys. Taking the third definition, half of the magnetic energy of self-induction divided by the current, we get in this particular transformer something less than one henry. Exactly what that means I have not been able to make out as yet.."

MR CROCKER: In regard to the unit of inductance being a question of length, I did not suppose that there was any question in the mind of any one who had spent more than a month or two studying electricity, as to the fact that these dimensions are arbitrary to a great extent, and differ with each system, but we have adopted the electro magnetic system, and we never use the electro-static system and are not likely to use it. Therefore it does give a certain importance to the dimensions of the unit being always expressed in terms of that system, and are always likely to be, and a thousand years hence these dimensions will probably be the dimensions of the system. Furthermore the language of the report which I presume brought forth this criticism simply states that 10 to the 9th power absolute units of induction, shall express a length equal to one earth's quadrant, which is certainly a fact, and it was given more to show why it was called a quadrant, in other words to cover the subject as far as possible. But, however arbitrary the dimensions of the unit—and if you use that word you know simply what they mean—that they are not absolute, but will change with the system, as we are not likely to change the system, why, the dimensions are not likely to change. As to the question of definition. I think that is a very important matter. In regard to the first question that Dr. Hutchinson mentioned as to how the value of the unit will be affected by the variations in the value of the ohm or volt; that will take care of itself. Ultimately, I presume, the volt will be the correct volt, and the ohm will be the correct ohm, and in that case the unit of self-induction will be the correct unit. In other words all the practical units will gradually undergo a perfecting process, and when any one of them is improved by experimental determinations they will all improve.

In regard to the importance of the unit of inductance, and the whole matter of self-induction, I believe that it will be used nearly as much as resistance, and that the unit of inductance will in the future have perhaps very nearly as many uses as ohms.

The question of exactly what the unit applies to—what the conception shall be aside from its value—a definition of that I think is also very important. The co-efficient of self-induction of course is the ordinary idea. But that is defined in terms of a unit change of current in a unit time. Now, as a matter of fact, supposing we have ten units change of current in a unit time, then we have ten times the self-induction. The co-efficient will be no greater, though. If we have a certain electro-magnet and we discharge it, we take out ten amperes of current, and cause ten amperes of current to cease flowing in one second. The actual self-induction would be that due to the change of current, ten amperes in one second. The co-efficient of self-induction would be calculated from a change of current of one unit in one second. Therefore you might say that you have the co-efficient of self-induction and the actual self-induction in any given case. It is entirely possible that you might have a variation of a tenth of an ampere in a second, but the coefficient of self induction would be that due to the unit change of current in a unit time. I think the distinction between the coefficient, which is a special case due to a unit change, or a unit variation of current in a unit time, is one thing, and the actual self-induction in any given case, which may be ten units of change or a tenth of a unit, is another thing. That is usually more important than the coefficient of self-induction, because that is what we actually get. The coefficient of self-induction is what we might get if we had a certain rate of change—a special case and not the particular case that we have in hand. That has not been pointed out, I think very distinctly. The coefficient of self-induction is usually spoken of as the most important thing. The actual self-induction is I believe very much more important than the coefficient of self-induction. Of course you can obtain the actual self-induction by multiplying the coefficient of self-induction by the particular change that takes place in a given case. In regard to the question of whether Henry is entitled to the credit of this discovery, which Dr. Hutchinson questioned, I would say that the reference by Mr. Lockwood in his paper last May, was evidently due to a discovery which was very vague indeed; whereas if you look back to Henry's publications which I have done, you will see that he distinctly observed the phenomenon of self-induction and distinctly gives the name, not self induction, but that the action was one of the current on itself, showing that he not only observed the phenomenon, but knew what it was due to, and gave the interpretation to it, and practically named it. That is when the actual discovery took place The mere observation of a phenomenon that is not understood is hardly a discovery.

A. E. KENNELLY: A very important matter is the question of how that unit shall be defined. If we had no iron it would be very simple, because all those three definitions of induction, the definition by which we refer it to back electromotive force the definition by which we refer it to the total number of lines of force through the circuit and the definition which defines it in terms of the energy accumulated in the circuit through induction, would all be one and the same thing in terms. But unfortunately in dealing with iron we come across a difficulty. Mr. Crocker has said that he thinks the definition with regard to back electromotive force is the one which conveys most clearly and most effectually the nature of inductance. I have the honor to differ from Mr. Crocker in this belief. When I see a coil I can imagine the number of linkages with that coil, and more readily estimate in this way its inductance than I could by forming a conception of its counter electromotive force with change of current. This is however, only a matter of opinion. But there is this advantage, that the method of referring inductance to the number of lines linked with a coil is one which is very fundamental and simple. It does not require any recourse to the differential calculus, as the others do, because the time rate of change has to be defined as the instantaneous time rate and not the time rate in any actual period elapsed. You must define the back electromotive force as at the instant and not in any definite thousandth of a second, or hundredth of a second that has passed by. You have therefore a language which savors of the differential calculus, and it is surely important that all of our definitions should be of the simplest possible nature when we are dealing with terms to be employed practically. Apart from that it is essential that the definition should embrace all those differences which are met with in practical measurements. If you take a coil with iron in it and you measure its inductance with a very feeble current you will get a comparatively large inductance, because the permeability of the iron at that moment is high and if you measure it with a secohmeter the inductance you will get will be a comparatively large one, because you measure indirectly the total effect of passing those lines in and out, and the back electromotive force of that on the circuit. But when you come to use a strong current you will get relatively a smaller inductance because you are saturating the iron up and you are not getting in proportion to the current anything like the same number of lines in and out of the coil and the result is that the apparent inductance of the coil will be less. It does not matter which definition you employ, it will not help you. It does not help you if you express it in the first definition, or the second or third. You will be hopelessly entangled and the results will be meaningless unless you specify the conditions of the test; even the measurement will differ with the particular form of apparatus employed, etc. The only hope, as it appears to me, is to specify that inductance shall be expressed by any of those three definitions, and then to say that the inductance with iron has to be referred to the inductance that would exist without the iron by the use either of the specified conditions of the test, or of the specified conditions of the iron.

C. O. MAILLOUX said: "Inductance has been defined as the product of a length by a permeability, with the assumption that the permeability is unity. Now I can conceive that we might express the inductance of the product of two factors, one of which is a coefficient simply whether we regard it as representing *length* or anything else (we might if we prefer call it a *length* factor or coefficient;) the other factor being what I might term the 'mean effective permeability.' Since the permeability undergoes a series of variations when the current rises from zero to the upper limits or maximum value reached in the given cycle, we have a series of values to consider. By integrating the curve of the permeability plotted with respect to the current (preferably) or with respect to the time (which would amount to the same thing) we can arrive at the mean effective value of the permeability for the cycle of current (or time) passed through. If we multiply this mean value by the length factor we have the mean effective value of the inductance. Now I submit that what we usually get when we measure

inductance is in reality the product of those two factors. Unfortunately we do not have the means of separating them, unless we regard the length coefficient as the inductance value that would be obtained if the iron were removed from the magnetic circuit; and regard the other factor (the mean effective permeability) as the factor indicating how many times the inductance is increased when the iron is present.

"We know, as Mr. Kennelly has just incidentally stated, when we confine ourselves to low currents, we obtain by measurement a higher value for the inductance. A reference to the curve just referred to of permeability as a function of the current will explain this readily, because the factor I call the mean effective permeability has under these circumstances a greater (mean) value; whereas, when the iron is carried at each cycle, to a higher degree of saturation by using stronger currents in the measurements the mean value of the inductance will be much smaller. I do not attach so much importance to our being able to separate the two (constituent) factors of the mean effective inductance. The principal thing needed is a value for the inductance which can be treated as if it were constant for a whole cycle, or a whole period, and which will reconcile theoretical ideas with practical requirements. I see no difficulty in this way of approaching the question. I think it clears some points, as it may be useful as a step toward defining the kind of inductance which we actually deal with in practice; for as I have intimated, our ordinary methods of measuring inductance give us a mean effective value which we then treat as if it were constant. This mean value must of necessity vary according to the limits between which the permeability varies under the conditions of measurement."

PROF. CROCKER said he thought it would be a great mistake to define the henry in terms of legal volts and ohms or whatever may be involved in the definition at the present time, making it necessary to change that dimension at some future date, and thus bring about all the infinite annoyance caused by the changing of the definition of the ohm every little while

CHARLES STEINMETZ: When you take into consideration the fact that this term inductance will be used mainly for explaining and calculating the phenomena of alternating currents, then the suggestions that Mr. Mailloux made —the introduction of this "effective value" of inductance —I suppose will be found more useful than even the true analytical term, inductance. Indeed, I cannot consider the choice of the name "effective" as a happy one, because that suggests something of square root of a mean square, and this value, which Mr. Mailloux means, is not the square root of the mean square of the different values of inductance during the magnetic cycle, but it is in reality very nearly the inductance for that value, which corresponds to the maximum magnetization used, and therefore I would prefer another name, which is not so liable to be misunderstood, for instance "resulting inductance." If the current and also the magnetism can be supposed to follow strictly the sine law, then this "resulting inductance" is exactly that value of inductance corresponding to the maximum current and maximum magnetization used. But if the current does not follow quite exactly the law of harmonic waves, but is an ordinary alternating machine current, then this resulting inductance of Mr. Mailloux will nevertheless be so near the inductance for maximum magnetization, that with the usual instruments a difference can hardly be detected, at least not so far as my experience goes; and I had occasion sion to make a great number, I believe over a thousand determinations of this value of self-induction, and of the work consumed by hysteresis, over a very large range, up to values where the hysteretsic loss amounted to more than a thousand watts, and I always found the value of inductance very near the value previously calculated for the maximum magnetization of the cycle, so near the slight differences which I found—less than 5 per cent—I can very well attribute to the errors of observation, to the inconstancy of speed of the steam engine, etc.

The report was adopted.

Telegraph Suit.

An Albany dispatch says: The Court of Appeals handed down a decision in the case of T. W. Pearsall against the Western Union Telegraph company, affirming the judgment of the lower court in favor of the plaintiff. This was an action to recover damages for the alleged negligence of the defendant in failing accurately to transmit a telegraphic message from Great Neck, Long Island, to New York. On July 31, 1884, some person, on behalf of the plaintiff, delivered to a telegraph operator at the station of the Long Island Railroad at Great Neck, without prepayment, a message for transmission to New York, addressed to "T. W. Pearsall & Co.," telling them to buy 1,000 shares of Western Union. This message was written, not upon one of the printed blanks of the company, but on an ordinary sheet of note paper with no conditions whatever printed thereon. The message was delivered at the place directed and paid for, but the words "& Co." had been omitted, the address reading simply, "T. W. Pearsall." No person in the office of the firm possessed authority to open a message thus addressed, consequently the telegraph remained unopened until Mr Pearsall arrived. In the meantime the price of Western Union had gone up and when the plaintiff purchased the stock on his return to the city he had to pay a higher rate than if it had been purchased at the time he telegraphed. He sued for the amount represented by the advance in price, recovered judgment, and the Court of Appeals now affirms the judgment.

The electric railway at Quincy, Ill., was started January 1, and is operating successfully. The Thomson-Houston system is employed. Thirteen cars are operated, and the system includes eleven and one half miles of track. The construction work was done by Woodbridge & Turner of New York.

CORRESPONDENCE.

New York Notes.

NEW YORK, Jan. 31.—The vigorous attack on the trolley system of electric traction since the Board of Electrical Control decided in its favor for the "Huckleberry" road is making it somewhat doubtful whether the consent of the property owners along the line can be obtained. It is said that many residents and property owners who at first seemed to favor the system have changed their minds. One of the residents is reported as saying: "Some months ago all the papers had a description of the elaborate plans of the Third Avenue company for the construction of its cable apparatus. Everything was promised on a scale of magnificence and completeness, far removed from what the Third Avenue road has led us to expect by its actions. Yet not a stone has been turned nor a shanty erected in view of this vast work. I believe that the Third Avenue road is behind the whole scheme. As soon as the 'Huckleberry' road obtains the privilege of using the trolley system, the Third Avenue will change its mind and apply for power to use the trolley system also. The 'Huckleberry' road application is only the thin edge of a wedge; the thick end will soon follow." Edward Lauterbach, who is a director of the Third Avenue company, denies the report, but says: "Had the trolley system been employed I believe that the value of property would have diminished. It is my impression that one or two stockholders of the Third Avenue railroad own small holdings in the so-called 'Huckleberry' road, options to purchase which, however, have been given to those interested in the change of the motive power of the 'Huckleberry' road. Whoever they are, I know that they are not Third Avenue people."

Mr. Lauterbach added that the "Huckleberry" road had asked permission to erect the trolley system in front of the Third Avenue stables at One Hundred and Thirtieth street. The request had not been granted, and is now under consideration.

John McLaughlin, a laborer employed by the Manhattan Electric Light company, removed a manhole plate at the southeast corner of Nineteenth street and First avenue at 1:30 yesterday. He found great quantities of gas escaping and held a lighted match in the opening. There was an explosion, and the flame from it enveloped the man in a moment, burning his face, hair and right hand.

The introduction of the rapid transit bill into the senate Monday, Jan. 5, the day on which the legislature met at Albany, has been followed with unusual attention. During the week it was passed by the senate and sent to the assembly, which approved it without amendment, and today the governor affixed his signature so that the promoters of the Corbin and the Greathead tunnel plans may join hands for an underground electric system for New York. The only strong competitors in the field are the Metropolitan Underground Railway company, under the directorship of Austin Corbin and the London company, whose representative is Louis Sterne. Chairman Steinway, of the rapid transit commission, expressed himself as entirely satisfied with the provisions of the bill and has called a meeting of the commission for immediate action. Mr. Sterne has promised that if his company gets the franchise the road will be completed in one year.

The work of repairing the damage done by the recent storm to electric wires is progressing as rapidly as possible. The telephone companies never had such an experience before, and the progress of their work is slow. Fully 3 000 subscribers are estimated to be without communication, and only 200 a day are being connected. General Manager Parker says that it will be two weeks before all circuits will be arranged again. The Western Union Telegraph company have practically settled its difficulties. It has connection with all important cities, and the smaller outside circuits are being rapidly closed. The general manager of the Western Union says that its difficulties are nearly over. The Postal Telegraph company makes a similar report, but it will be two weeks before its circuit will be perfect. The police wire system is established, although not perfectly. The fire lines are however, about the same as they were the day after the storm. They cannot do much in the way of connections until the telephone wires are fixed. The Long Distance Telephone company has recovered direct service to Boston by both the Shore line and the main line. The gaps between Inwood and Kingsbridge have been temporarily spanned by means of cables, and it is believed that to day all the private leased lines will be in order.

Another horse was killed by electric light wires in Newark yesterday morning, making five which have met their death in that manner there since the opening of the year. John Waddington, newsdealer, was driving along Broad street at 5 o'clock in the morning when his horse came in contact with a loose coil of telegraph wire which was hanging down from an electric light wire. The horse became entangled in the coil, pulling it taut and cutting it through the insulation on the light wire.

The New York *World* is a model of inconsistency—one day crying for rapid transit, the next attacking measures designed for that purpose. Just now it is displaying bad temper, poor judgment and lamentable ignorance in its treatment of the question of overhead electric railway systems It denounces the Board of Electrical Control, Mayor Grant and everybody else who assisted in the project designed to grant the residents of the annexed district good railway service. If the all-knowing writers on the *World* would examine the practical workings of the electric system they might obtain some information that would show them the advisability of refraining from displaying their ignorance to the public.

Frank Fiske, the murderer, was sentenced by Judge Adams to-day to be executed at Auburn during the week of March 22.

Lyman D. Davis, an electrician of Newark and a nephew of Gov. Hill, died last week. He was twenty-six years of age and, had lived in Newark about eight years.

Judge Truax of the Superior Court has granted Edward Henry's application for a permanent injunction restraining the mayor and the other members of the Board of Electrical Control from making any contract with the Empire City Subway company for the construction of subways; and from relieving the Consolidated Telegraph & Electrical Subway company from any of its obligations under its contract with the board until the contract is terminated or has become inoperative or ineffectual. W. H. T

Pittsburg, Pa.

PITTSBURG, Pa., Jan. 31 —The Central District Telephone company of Warren, Pa., has commenced suit against the Warren Electric Light & Power company for an alleged induction of the electric light wires. The telephone people ask that the light company be required to remodel its circuits, or if that change will not prove a remedy, they demand an injunction.

At the Edgar Thomson steel works of Carnegie Bros. & company, near this city, a man named William Brown was killed this week by a shock from an electric wire. A wire of the arc light system used in the works had fallen from a pole, and it was cut in two by a passing freight engine. One of the employes picked up the wire and threw it over Brown's head, when he received the shock, and subsequently died.

A heavy windstorm blew over Allegheny City Thursday, and played havoc with the electric wires of the city police patrol system, and also with the wires of the Allegheny County Light company.

The Westinghouse Electric & Manufacturing company has just brought out a new type of electric street railway motor. It is a slow speed multipolar machine of exceedingly simple and very substantial construction. The first pair of these machines has been completed, and they have now for some time been running on one of the cars of the Second Avenue Electric Street Railway company, where the apparatus is giving excellent satisfaction.

It was stated here the other day that the American Flint Glass Workers' Union, a national organization of all the flint glass employes in the United States is now engaged in breaking down, what it chooses to call one of the greatest monopolies that has ever existed in the glass business of this country. The Houghton Glass company of Corning, N. Y., has for some time had a monopoly on glass bulbs for incandescent lamps. These bulbs are made in two ways, some in paste moulds and others are made off-hand. The latter kind is made by the Houghton company, and is said to be exclusively used by the Edison company. The Westinghouse company use some bulbs made in the moulds, but they are said to also use a great many of the off-hand made bulbs.

In the manufacture of the latter there is a secret process employed which is said to be possessed only by the employes of the Houghton company. The glass used for the mould process will not do for the hand process. The factory employed 310 blowers and a total of 1,050 workmen, and had a capacity equal to any eight union factories. The men found that they were being paid only $2.50 per day for work for which union men received $4.58. They organized into the American Flint Glass Workers' Union, and then struck for recognition of the union, and for union wages.

The strike has been going on for some time. Secretary Dillon, of the union, states that the organization proposes to transfer about 60 of the men who know the secret of the off-hand process, into factories where these bulbs are not made now, and by that means it is proposed to break the monopoly on these goods, now being enjoyed by the Houghton company. Whether the attempt of the strikers

will be successful or not, it is said that it will have the effect of making incandescent lamp bulbs scarce for some time.

The difficulties which have for some time been in existence in the McKeesport Electric Light company, mention of which fact was made in this correspondence not long ago, has not been settled yet. A few days since the Edison General Electric company, the Edison Light company and several of the stockholders of the McKeesport company, asked the Pittsburg court to appoint a receiver to take charge of the business of the company. The whole trouble arose out of the fact, that at the last annual meeting of the company an amendment to the by-laws was passed, increasing the number of directors from five to seven. The directors and Mr. White, the president of the company, who comprised the minority of the stockholders, obstructed the business of the meeting, it is claimed, and prevented an election with the alleged intention of remaining in office indefinitely. E. H. H.

Nashville, Tenn.

NASHVILLE, Jan. 30.—The case of the Cumberland Telephone company against the United Electric Railway company, in which the complainant sought to enjoin the defendant from operating a single trolley electric system, has been dismissed from the Federal court for this district on motion of the complainant. It is understood that a new suit for damages will be brought in a state court by the telephone company, on the ground that the railway circuits have interfered with and in many cases destroyed the usefulness of the telephone wires.

A controversy between the electric railways and the railroads leading into this city, in regard to the coal supply and discriminating freight charges, has just come to light. It will certainly be a subject of legislative investigation, and there is a strong probability that it will finally come before the inter-state commerce commission and the courts, federal or state. The matter was first made public by T. W. Wrenne, president of the United Electric Railway company, It is charged by Mr. Wrenne that coal for steam generation is delivered to most of the city manufacturing concerns for four cents per bushel the year round, while his company and some others, as well as the general public, are charged a variable rate, from four cents in spring and summer to six and a half cents in winter. The railroad men admit this, but offer as a reason for giving lower rates to the manufacturers that they transport all their raw material and their finished products, and that it is to their interest and that of the state to foster and build up such concerns. But the controversy has brought to light, it is claimed, the fact that the Nashville Gas Light company get a uniform rate of four cents a bushel on coal, while the Capital Electric Light company, whose power plant is located very near the gas works, is now paying a six and a half cent rate. The whole matter has been laid before a special legislative committee and will doubtless result in a railroad commission and some stringent enactments.

At the annual meeting of the Capital Electric company all the old officers were re-elected except Adolf Dahlgreen, who voluntarily declined the position of treasurer and manager. The employes presented him a handsome gold-headed cane and an address commending his services and regretting his retirement.

The municipal authorities have ordered a number of additional arc lights placed in the newly added territory, and also the relighting of gas lamps that have been out of use. This was done because accidents to machinery have made it impossible for the electric company to light certain portions of the city.

The action of the city authorities in applying to the legislature for power to issue bonds to build a new gas plant has drawn from the gas company a proposition to renew its its contract with the city, which expires next fall, for a period of thirty years, at $1.50 per 1000 feet of gas, the present price being $1.89. The special committee to which the matter was referred unanimously rejected the proposition. This committee was unwilling to entertain a proposition at any price for a longer period than ten years, and a majority preferred two or five years. The members of the committee were fully impressed with the belief that improvements greatly decreasing the cost of city lighting will be made during the next ten years.

The Citizens' Rapid Transit company is now transporting passengers to the end of its line in West Nashville by transferring at the unfinished bridge. A large force is at work on the bridge piers and approaches, but it is a costly structure and will require months to complete. The power house is located between this city and the bridge, and is equipped with a large Corliss engine and a single generator. The line works smoothly, but only three of the five cars are run regularly.

Work on the power house of the Electric Railway & Power company has been retarded by bad weather. It is of wood, two stories high, and lined outside with heavy corrugated sheet iron. The Detroit Electrical Works have the contracts for furnishing two 80-horse power dynamos and also the car motors.

The Postal Telegraph Cable line has been completed to Franklin, Ky., fifty-five miles from here. There is still a gap of about 130 miles before direct connection can be had with its lines north of the Ohio. B.

Denver, Colo.

DENVER, January 31.—After much delay and considerable trouble, the Denver, Lakewood & Golden electric railway has at last secured all the franchises necessary for the right of way, and made the necessary arrangements for terminal facilities in both this city and Golden. Its eastern terminus will be on Lawrence street between Fourteenth and Fifteenth streets. A connection with the Lawrence street electric line will be made at West Fourteenth and South Ninth, and a third track will be laid to Fifteenth street to accommodate the freight traffic of the Golden line. The history of the Denver, Lakewood & Golden, and its operations and alliance with other lines is extremely interesting. When the time for the Golden road to secure an entrance into the city arrived, the suburban electric line was also looking in the same direction. The suburban was building in direct opposition to the Tramway and City cable systems and the officials of both these corporations had an interest in checking its plans. The Golden line held the key to the situation. It was possible for it to continue with either company. The City cable lines were available at the western terminus of the West End electric or the Larimer street cable, both ending at Sloans lake, three miles west of Fifteenth street. The Tramway people saw the advantage of uniting with the Golden line, and securing a western outlet, and the result was the present alliance which gives the Tramway access to a field heretofore monopolized by the City Cable company. Half hourly service to Golden will be given by the new line, and the fare will probably be twenty-five cents. Electric motors of forty and fifty horse power will be used and the cars will be of the latest pattern.

The question of securing rapid transit for Harmon, an eastern suburb is being agitated and public spirited citizen are subscribing to the fund of $15,000 required to secure the completion of the suburban electric road through South Capitol Hill addition. Nine thousand dollars have already been subscribed.

It is reported that the electric light company which has the contract for furnishing South Denver with light, will ask for a franchise for car lines.

The contract with the electric light company in Highland permits the town to run two lines of wires on the poles of the company for fire alarm purposes, and the service will soon be established.

The Golden Illuminating company is now putting in a new engine to drive two additional dynamos necessary to furnish the increased demands for lights in that place. C. W. C.

THE ELECTRIC LIGHT.

An electric light plant will be erected at Madisonville, Ky.

New machinery has been installed in the Staunton, Va., electric light company's plant.

A new company will be organized at Bristol, Tenn., to operate the electric light plant.

The city council of Dayton, Tex., is negotiating for the erection of an electric light plant.

The Maysville, Ky., Gas Light company announces its intention of establishing a plant for electric lighting.

Through a technical error the electric light franchise of Lebanon, Mo., is invalid. In the meantime the plant has been put in and the progressive city has enjoyed the lights for a month. A new election on the outlay will be held.

The San Diego Electric Light & Gas company has elected W. W. Stewart, E. H. Bushyhead, R. H. Dalton, E. Westcott and R. M. Powers, directors; R. M. Powers, president and general manager; F. W. Jackson, secretary; G. I. Kinney, superintendent; R. S. Clarke, chief engineer.

The new electric light station at Norwalk, Conn., will be built by the Berlin Iron Bridge company of East Berlin, Conn., from that company's own designs. The building will be 60 by 70 feet, and will have a 2-ton traveling crane extending the whole length of the building. The construction will be entirely of iron, fireproof, and is expected to be a model station of the kind.

The Chicago *Evening Post* says, editorially: "It has always been easy enough for doctrinaires to convince themselves that a municipal corporation has not the right to manufacture and sell gas to its citizens. To denounce such projects as socialistic and outside of the legitimate functions of a government comes as easy as lying to a large and respectable body of citizens." It might also be added that there are many well meaning and eminently respectable citizens who believe because they have been traduced by irresponsible newspaper writers that a state censorship should be established.

G. W. Beggs and J. E. Lee, of Bessemer, and H. T. Beggs have incorporated the People's Electric Light & Gas company, Birmingham, Ala., for electric and gas lighting purposes. The capital stock is $100,000. The Stevens Electric company has, it is stated, increased its capital stock to $50,000, and contemplates putting additional machinery in its electric light plant.

THE ELECTRIC MOTOR.

The Atlanta, Ga., Street Railway company has decided to operate its lines by electricity.

It is reported that the Citizens' street railway of Michigan City, Ind., was sold last week to a syndicate of Chicago capitalists, represented by E. D. Cummings. The consideration was $22,500, and the line is to be extended in the spring and equipped with electric motors.

D. H. Bates, vice-president and general manager of the Accumulator company, New York, announces that the negotiations which have been pending for sixty days between his company and the Eckington & Soldiers' Home Railway company of Washington, D. C., have resulted in the execution of a satisfactory contract for the equipment of the new G street branch of the latter company with six storage battery cars. The Eckington & Soldiers' Home Railway company was one of the first street car roads in the United States to adopt electricity as a means of propelling its cars, and the Thomson-Houston system of trolley wires installed several years ago upon that road, extending from Seventh street and New York avenue in Washington, D. C., to Eckington and the Soldiers' Home in the northeastern part of the city, has been one of the most widely known and successful in the country. Congress, however, will not permit the railway company to erect additional trolley poles. The cars for the Eckington & Soldiers' Home road are being manufactured by the J. S. Brill company of Philadelphia, and will be upholstered and finished in handsome style, lighted by electricity, equipped with the Edco system of motors and gearing, with dust-tight covers for motors, and with a sufficient number of the 23M type accumulators, made by the Accumulator company, to obtain an average speed of eight miles an hour, and a maximum speed; when desired, of fifteen miles an hour. The Brill company has promised the cars for the last of March, and they will be equipped and installed in running order within sixty days thereafter. The factory of the Electro-Dynamic company is being run three nights a week, in order to keep up with its orders for dynamos, motors, gearing, switches, etc. The six storage battery cars which the Accumulator company is under contract to deliver to the Dubuque Street Railway company, are rapidly approaching completion, and will be delivered and installed some time this month.

Miscellaneous Notes.

The Chicago Insulated Wire company has been incorporated at Chicago; capital stock, $50,000; for the manufacture of bare and insulated wire and insulating materials; incorporators, William G. Adams, Herman W. Plautz and Paul Brown.

The annual meeting of the Standard Underground Cable company was held January 27 at company's office in the Westinghouse building, Pittsburg. It was well attended by the stockholderss, there being nearly 9,000 shares represented. George Westinghouse, Jr., was elected president and the following gentlemen were elected directors: George Westinghouse, Jr., Mark W. Watson, John H. Dalzell, Robert Pitcairn, Joseph W. Marsh, James H. Willock and H. S. Sweitzer. The annual report of the Board of Directors was exceedingly gratifying to the stockholders; it showed that the company's business for the year 1890, amounted to $917,946.62, representing an increase of 50 per cent. over the business done in the year 1889. The net earnings for the year 1890 were $204,913.78, or a little over 20 per cent. on the entire capital stock; two dividends, aggregating $30,000, were paid during the year, leaving the net addition to surplus account $174,913.78. The company's net surplus on December 31, 1890, was $315,735.85 The raw materials used by the company during the year were as follows: 342,549 pounds of cotton and jute yarn, 1,625,209 pounds of copper, 1,853,338 pounds of lead. During the year 1890 the company added eighty-four new customers to its already large list, and its business covers a wide range of territory, as is graphically illustrated by the large map of the United States shown in the company's office, nearly every state and territory of which is dotted with circles or crosses indicating the cities in which the company's underground cable or overhead wire, are in use; and the markings on Johnson's commercial chart of the world shows that the company's business is not limited to the United States, but extends to Mexico, South America, Europe, Africa, Asia, China and Japan. The new board of directors will meet some time during the week for the purpose of electing officers.

Personal Mention.

C. A. Benton of the Detroit Electrical Works, was in Chicago last week.

W. S. Turner, of Woodbridge & Turner, New York, was in Chicago last week.

C. E. Stump, of the *Street Railway Journal* of New York, was in Chicago last week.

Wm. H. McKinlock, president of the Central Electric company, Chicago, met with quite a painful accident a few days ago, which confined him to his room for several days. In running for a train he stumbled and fell headlong into the street, but fortunately, escaped anything more serious

than a sprained ankle. Mr. McKinlock has so far recovered as to resume his duties.

H. F. Lufkin of the C. & C. Motor company, New York, was in Chicago last week.

Business Mention.

The Western Electric company, Chicago, has just issued a catalogue of electrical house goods for 1891. This neat little pamphlet contains cuts and prices on annunciators electric bells, pushes, batteries and other electrical specialties manufactured by this company. Those who from time to time purchase electrical house goods will find the Western Electric company's catalogue a valuable addition to their usual collection.

The Moore Bros , New York, Electrical manufacturers, and James H. Bates, New York, have incorporated the Moore Electrical Manufacturing company, with John L. Moore president, Erastus D. Moore treasurer and James H. Bates secretary. The new company will manufacture electric apparatus and supplies, and will be prepared to handle any class of electric work. The offices are at 106 and 108 Liberty street, New York.

J. Jones & Son, manufacturers of and dealers in electrical apparatus and special machinery, 602 and 604 West Twenty-second street, New York, announce that they have bought out the plant of the late firm of Chapin & Thompson at the address named, and will carry on a general manufacturing electrical business. The firm has been appointed by the Berlin Demagnetized company, sole manufacturers and selling agents of the now well-known and popular watch demagnetizer.

Dr. Philip Atkinson, author of "Elements of Electric Lighting," says of the Ajax dry battery, of the Electrical Supply company, Chicago: "During the past year I have used an Ajax dry battery of six cells for laboratory and lecture room work, such as electrolysis, incandescent lighting, electric measurement, and energizing electromagnets, with the very best results. It has shown no defects, has maintained constancy, and is now apparently as efficient as when first put in use."

The Electrical Supply company, Chicago, has received the following from the Mountain Electric company of Denver: "In installing isolated plants throughout this state we carefully investigated the various makes of rubber covered wire. After sending for the samples of nearly every standard brand we finaly decided to use Habirshaw wire solely, for the reason that we consider it best. To indorse this statement we think it is only necessary to add that the cost of the wire is higher than any other wire quoted us. We are also very glad to inform you that we shall soon send in an order for a large quantity of this wire as we have recently obtained the contracts on three new buildings. Trusting that this will give you a practical proof of what we think of Habirshaw wires, we are," etc.

The descriptive catalogue of the Rodney Hunt Machine company of Orange, Mass., will be examined with great interest by those who are considering the use of water power for operating electrical plants. The company has been manufacturing turbine water wheels for thirty years, and the catalogue represents and illustrates the improvements which have been made in that period. The company says: "It has been our constant aim so to improve our water wheels as to meet the just reqirements of the most progressive manufacturers. How far we have succeeded will appear in the testimony of prominent manufacturers using water wheels made by us. Without claiming to have reached perfection, we invite comparison of our water wheels with other wheels for which the makers claim so much, confident it will be found fully equal to any other in every particular, and in some important respects, we believe, will be found to have decided advantages over any other make of water wheels."

The first annual report of the board of directors of the Electric Mutual Insurance company of Boston, Mass., was presented to the stockholders by President Barton, January 20. The report calls attention to the fact that outstanding risks amount to the large sum of $2,897,587, the premium of which is $30,320.71, an average rate of about 1 1-5 per cent. The average amount of policies is $9,055. The actual cash assets, after paying every dollar of taxes, expenses, including costs of organization, equipment of office, etc. and losses, amount to $18,907.04. The report adds: "Several fires have occurred in electric stations, but nearly all of them have been traceable to carelessness of construction, or failure to provide any facilities for the extinguishing of fire—faults due wholly to the unusually rapid development of the industry. A more deliberate, permanent and extensive era of construction has set in and the mistakes and neglects of the past are not being repeated." The outlook for the company, the directors think, is excellent. It has received encouragement from all sides and it has prospered far beyond the most sanguine expectations of the stockholders.

The Chicago Electric Manufacturing company, 73 W. Jackson street, Chicago, J. D. Claghorn, manager, has taken a new departure that will be appreciated by inventors and all others that have use for insulating and other material so essential in the making of high class apparatus. Mr. Claghorn has in stock a large line of vulcanite insulating material in sheets, rods, tubes and other forms which will be cut to order in any way desired, thus saving much delay and expense. He will also carry in stock a full assortment of brass and copper in the usual sizes so that a minute piece or a bar of the largest size can be secured, enabling any one engaged in experimental work to get the material wanted, cut to the exact size at a moment's notice. This company is also prepared, with the latest improved machinery and unquestioned mechanical and scientific ability, to assist in the development of new electrical and other inventions, and will give estimates and details promptly and in an intelligent manner to any one desiring high-class work. In addition the factory is well provided with facilities for manufacturing specialties or standard articles for the trade, for which estimates are solicited.

Since the Central Electric company of Chicago decided to go into the railway supply business, it has been looking thoroughly into the subject, and announces that it will shortly put upon the market railroad specialties entirely its own. The company has just introduced a new voltmeter and ammeter, the patents for which have passed into the control of this company. The instrument is certainly of a fine appearance, and will doubtless meet a ready sale among persons who desire a reliable, and at the same time, a moderate priced instrument of this class.

The following communication has been sent to the WESTERN ELECTRICIAN: "During the last week or so a false report emanating from some source inimical to our interests has gotten into the papers announcing the contemplated removal of the Ball Engine company to Elizabeth, N. J. This report is utterly untrue, and we wish to have it corrected and contradicted. The Ball Engine company will continue to manufacture the Ball engine as hitherto at Erie, Pa. We have just completed a large foundry, and have the plans prepared for an extensive addition to our plant. We expect to commence the erection of these buildings Feb. 15th, and the capacity of the works will be doubled. This extension will be equipped with the latest and most improved types of machinery, much of it especially designed for this class of work. Everything in fact has been planned with the end in view of getting out the most perfect and exact work. The appliances, such as traveling cranes, etc., will be the very best, and capable of handling very large engines. These improvements will make the works of the Ball Engine company the most complete of their kind in the country for the building of high speed, automatic cut-off engines, especially adapted for electric lighting, electric street railways, and other interests requiring strictly first-class engines. C. W. Laurie, who is at the head of the engineering force of the company, is a gentleman with a thorough experience in practical and theoretical steam engineering, and has made a special study of high speed engine work for years. It is the intention of the Ball Engine company to embody new features which will, in addition to the other well-known features of the Ball engine, make it the standard for good workmanship and material, perfect regulation and economy. During the past year, and at the present time the volume of business has been so great that, although the works have run steadily night and day, the company have been compelled to refuse orders for prompt delivery. With the new extensions and increased facilities however, the company will be able to give much prompter delivery. Some of the largest and most complete electric light and electric street railways in the country are now being equipped with the Ball engine."

Among the recent shipments made by the Ball Engine company of Erie, Pa., are the following: Southern Railway company, St Louis, Mo., two 150-horse power tandem compound engines; Central Passenger Railway company, Louisville, Ky., two 150-horse power engines; Buffalo Street Railway company, Buffalo, N. Y., one 300-horse power double compound engine; Rochester Railway company, Rochester, N. Y., three 150-horse power engines, one 300 horse power double compound engine, one 300-horse power triple expansion engine; Bessemer Electric Light company, Bessemer, Ala., one 100-horse power simple engine; Lewistown Electric Light company, Lewistown, Pa., one 125 horse power simple engine; L. S. Allison, Minersville, Pa., one 100-horse power simple engine; Andrews, McLean & Co., Passaic, N. J., one 35-horse power simple engine; Charlottesville Electric Light company, Charlottesville, Va., one 80 horse power simple engine; Warren Electric Light company, Warren, Pa., one 60-horse power engine; Norton Bros., Maywood, Ill., one 50-horse power simple engine; B. O. & G. C. Wilson, Boston, Mass., one 35-horse power simple engine; Brooklyn Riding Club, Brooklyn, N. Y., one 50-horse power simple engine; Silver Bow Electric Light company, Butte, Mont., two 150 horse power tandem compound engines; Russell, Burdsall & Ward, Port Chester, N. Y., one 35-horse power simple engine; Central Light & Power company, Clearfield, Pa., one 80-horse power simple engine; Milford & Hopedale, Street Railway company, Milford, Mass., one 60-horse power tandem compound; one 35-horse power simple; Portsmouth Gas company, Portsmouth, N. H., one 150-horse power tandem compound; International Okonite company, Passaic, N. J., one 35-horse power simple engine; Luyties Bros., New York, N. Y., one 60-horse power simple engine; Agnews Asylum for Insane, Santa Clara, Cal., one 60-horse power simple engine; Bradford Electric Light company, Bradford, Pa., one 150-horse power simple engine; Ballston Electric Light company, Ballston Spa, N. Y., one 60-horse power tandem compound; Edison Electric Light company, Brooklyn, N. Y., one 250-horse power double compound; Edison Electric Light company, Mt. Carmel, Pa., one 100-horse power simple engine; Cleveland Cable Railway company, Cleveland, Ohio, one 35-horse power simple engine; Puyallup Light, Heat & Power company, Puyallup, Wash , one 100-horse power simple; Maxwell House company, Nashville, Tenn., one 80-horse power simple engine; Herkimer Electric Light company, Herkimer, N Y , one 100-horse power tandem compound; Fidelity Trust company, Tacoma, Wash , one 80-horse power simple engine; Newark Passenger Railway company, Newark, N. J., one 150-horse power simple engine; Newark Passenger Railway company, Newark, N. J., one 100-horse power simple engine; Excelsior Electric company, New York, N. Y., three 70 horse power simple engines; C. E. Adams, Spencer, Iowa, one 90 horse power simple engine; Titusville Electric Light company, Titusville, Fla , one 35-horse power simple engine; Messrs. Dodge Bros., Newburyport, Mass, one 35-horse power simple engine; Howell Electric Light company, Howell, Mich , one 80-horse power simple engine; Hotel Columbia, Vancouver, Wash , one 35-horse power engine; Hotel Perkins, Portland, Ore., one 35 horse power simple engine; Union Pacific Railroad, St. James, Victoria, Portland, Ore., one 25-horse power simple engine; Washington School for Defective Youth, Vancouver Wash., one 25-horse power simple engine.

Electrical Patents.

Issued January 27, 1891.

445,161. Automatic Time Stamp. Henry A. Chase, Boston, Mass.

445,176. Electric Arc Lamp. Joel A. Hayes, Carson City, Nev.

445,207. Electric-Magnetic Motor. Nikola Tesla, New York, N. Y.

445,217. Thermal Cut-Out. Albert Barrett, Kansas City, Mo.

445,220. Coin-Controlled Electric Coil. Edward J. Colby, Chicago, Ill.

445,234. Electric Cable. John C. Reilly. Brooklyn, N. Y.

445,253. Electric Cut-Out. John S. Potter, Newton, Mass.

445,295. Electric Bell. John F. Wollensak, Chicago, Ill

The claim reads as follows:

"In an electric bell, the combination of a supporting frame. an armature, and independently adjustable magnet-spools movable toward or from the armature."

445,306. Circuit-Controller and Alarm. Charles M. Woolcott and Albert E. Wilmot, New York, N. Y.

445,310. Electric Switch. George Cutter and Charles G. Armstrong, Chicago, Ill.

445,341. Electric Guest-Call. Alexander Striemer, Sleepy Eye, Minn.

445,362. Cut-Out. Sigmund Bergmann, New York, N. Y.

445,363. Electric Cut-Out. Sigmund Bergmann, New York, N. Y.

445,364. Key for Electric Cut-Outs. Sigmund Bergman, New York, N. Y.

445,365. Electric Cable Connector. Sigmund Bergmann, New York, N. Y.

445,374. Manufacture of Carbon Filaments William M. B. Keen and William F. Haarmann, New York, N. Y.

445,409. Turn-Out for Electric Railways. Rudolph M. Hunter, Philadelphia, Pa.

445,422. Secondary Battery. Charles F. Brush, Cleveland, Ohio.

445,425. Galvanic Battery. Walter A. Crowdus, Mem phis, Tenn.

445,442. Telegraph Key. John Doggett, Plain City, Ohio.

445,448. Regulator for Dynamo-Electrical Machines. John H. Holmes, Newcastle-on-Tyne, England.

The dynamo electric machine is constructed with two armatures arranged to revolve together, but in separate magnetic fields. The one is the main generating armature, the other being for regulating the strength of the magnetic field of the generating armature.

Claim two reads as follows:

"In a generating-dynamo for lighting railway trains, the combination, with the ordinary shunt exciting-circuit for the field magnets, of a supplemental exciting-circuit connected to an external independent source of electric current, and to the armature-circuit of a regulating dynamo subject to the same variations of speed as the generating dynamo, the electromotive force of the armature circuit being opposed to that of the independent source of current, so as in counteracting it to a greater or less degree, according to the speed of the regulating armature, to maintain the electromotive force of the generating dynamo practically uniform.'

445,475. Telephone. Eloy Noriega, Mexico, Mexico.

The invention consists in a transmitter provided with a wooden diaphragm and furnished with fixed and movable annular electrodes, and in a receiver furnished with bobbins having cores formed of a number of separated pieces.

445,479. Electric Connection for Track-Wiring. Sidney H. Short, Cleveland, Ohio.

445,495. Leak-Detector for Pipes. Andrew H. Brown, New York, N. Y.

445,499. Electric Motor. William M. Dresskell, Brainerd, Minn.

The claim is:

"In an electric motor, the combination, with the armature coils, of an insulating disk carrying series of contact points connected with the armature-coils, and two three-armed switch-arms placed upon the armature shaft, insulated from each other and from the shaft, and adapted to change the connections of the armature from series to parallel, or the reverse."

445,515. Conductor Switch for Electric Railways. Frank J. Sprague and Johann F. S. Branth, New York, N. Y.

The last claim reads:

"5. In an electric railway, the combination of branching conductors on which a contact device travels, and a tapering switch plate at the junction of said conductors, across whose surface the contact device moves, said plate having side ribs, depressing ribs at its extremities, and a movable deflecting rib."

445,521. Commutator Brush Holder for Electric Motors. George H. Condict, Philadelphia, Pa.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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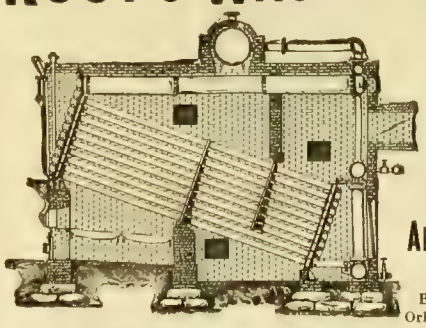

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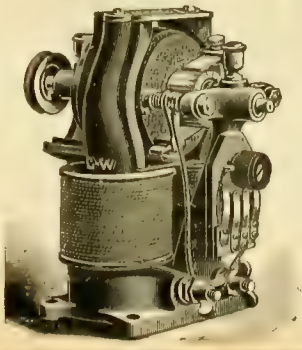

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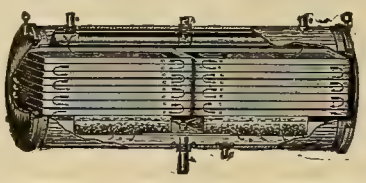

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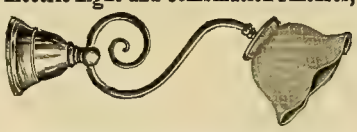

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List of all Isolated Electric Light Plants, with Number and Kind of Lights.

List of all Gas Companies, with Capital Stock, Officers, Price of Gas and Financial Standing, including all Gas Companies operating Electric Light Plants.

List of all Street Railway Companies, with Capital Stock, Officers, Miles of Track, Gauge, Kind of Rail, Number of Cars and Horses, Motive Power, if Electric, Cable or Steam, and Financial Standing.

List of all Telephone Exchanges and Licensed Companies, with Officers and Financial Standing.

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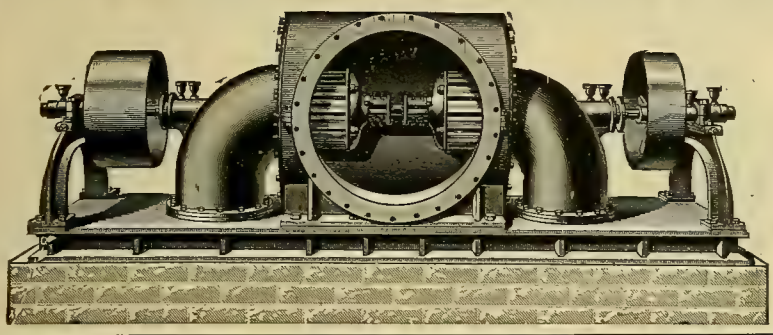

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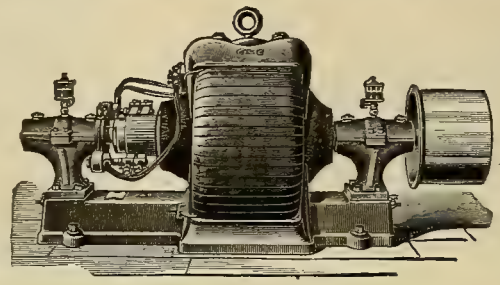

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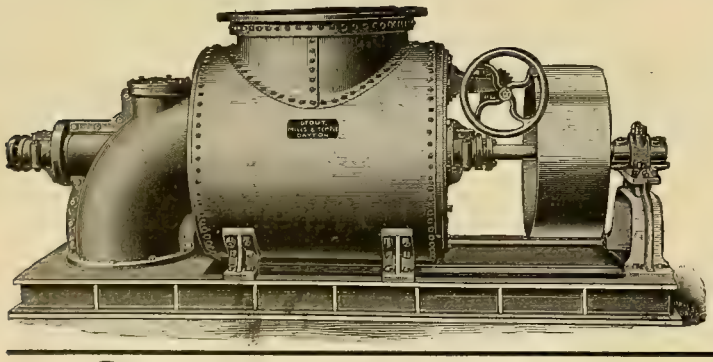

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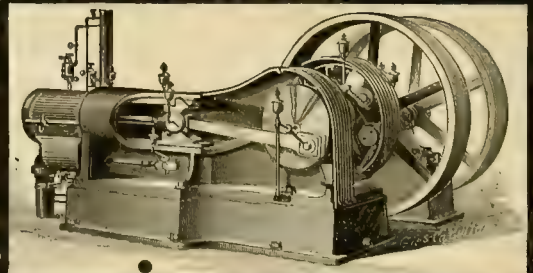

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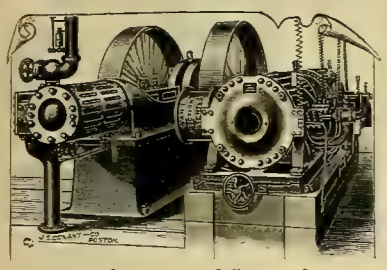

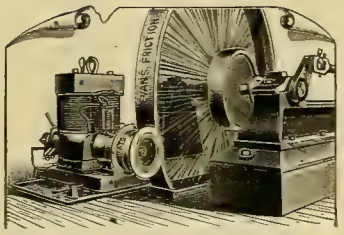

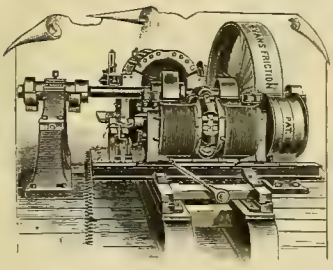

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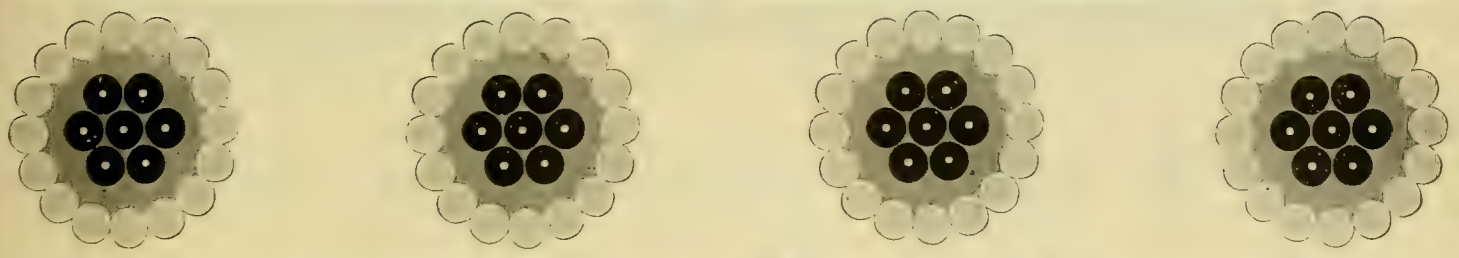

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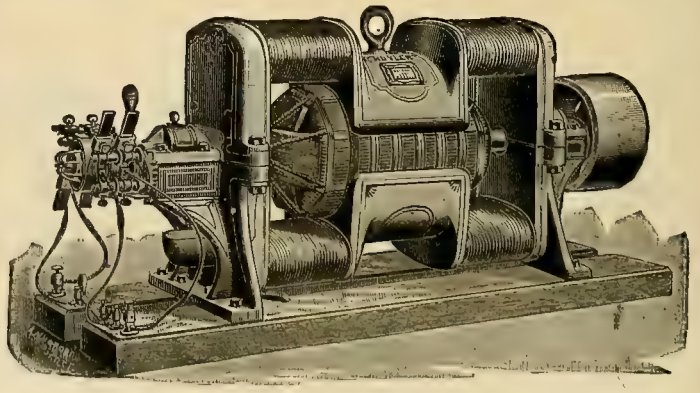

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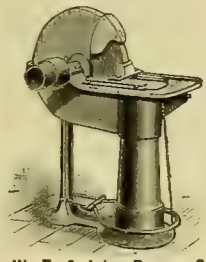

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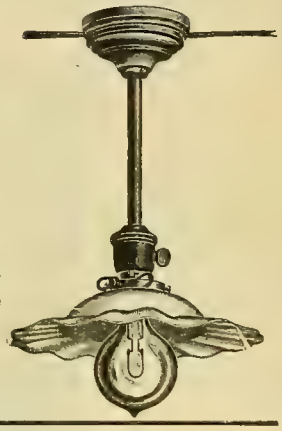

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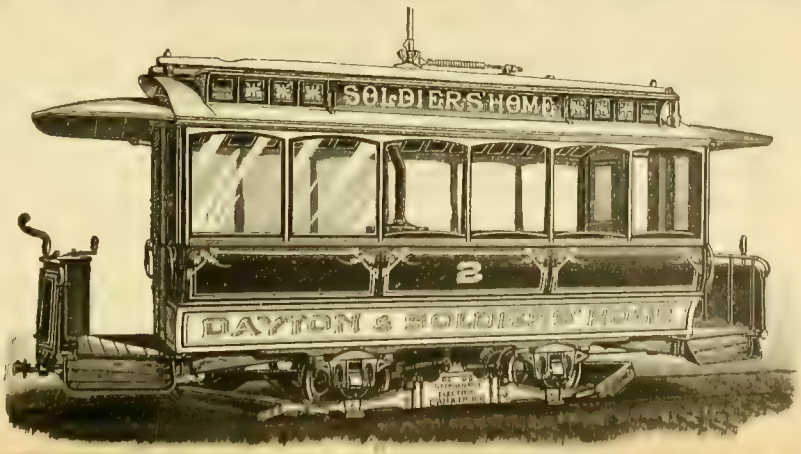

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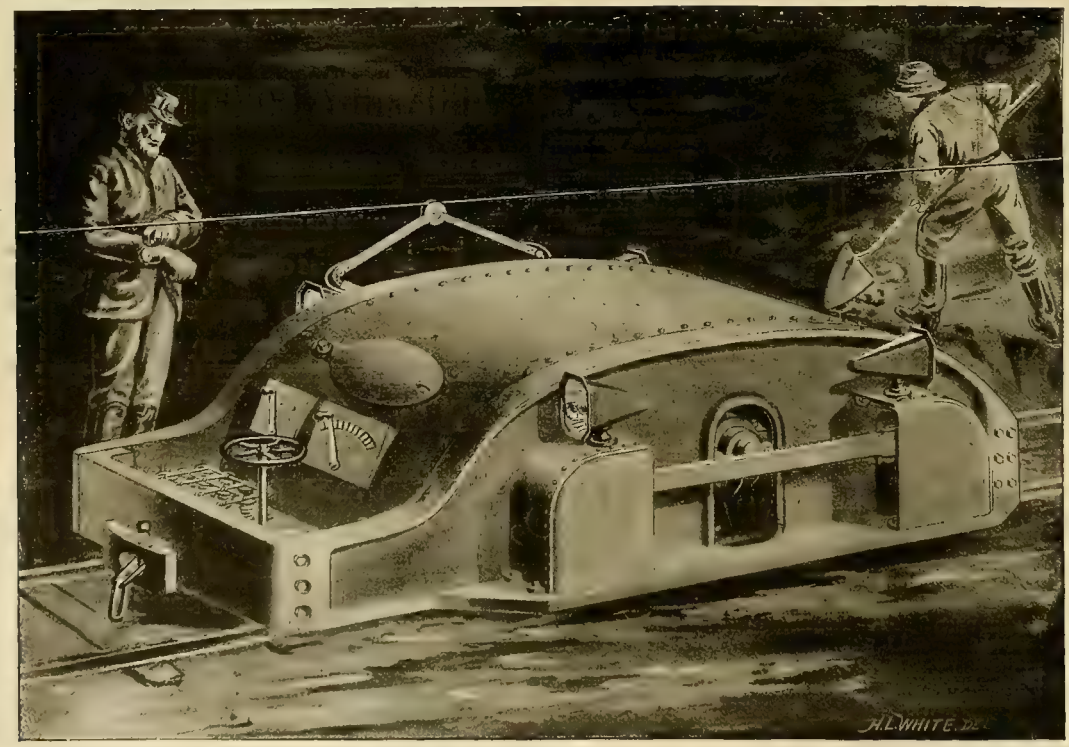

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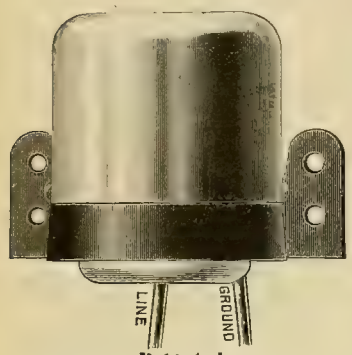

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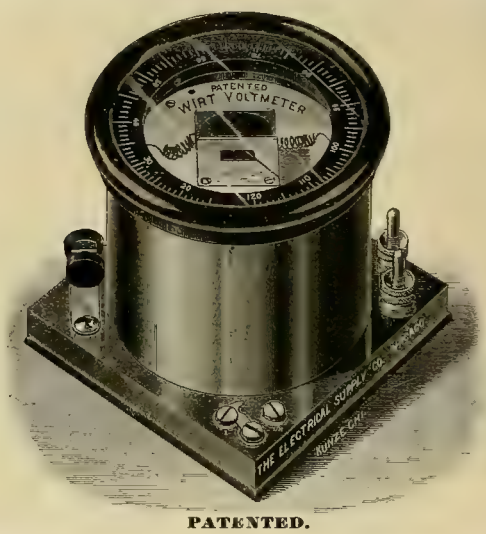

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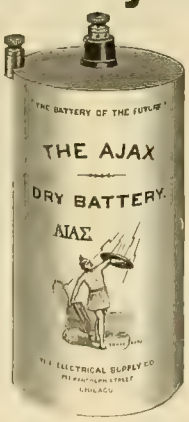

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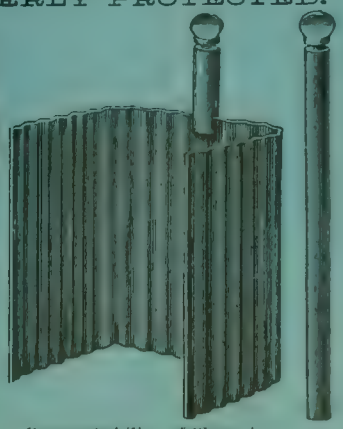

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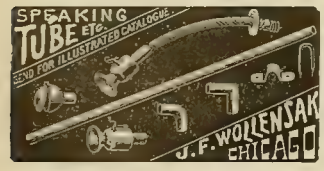

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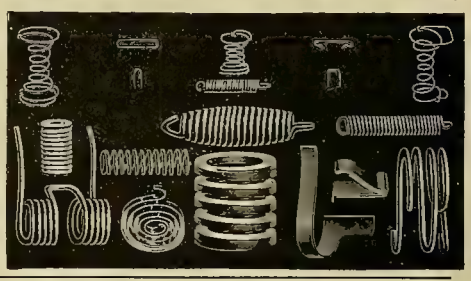

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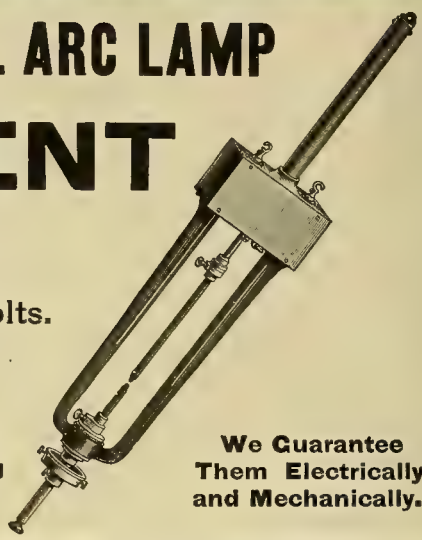

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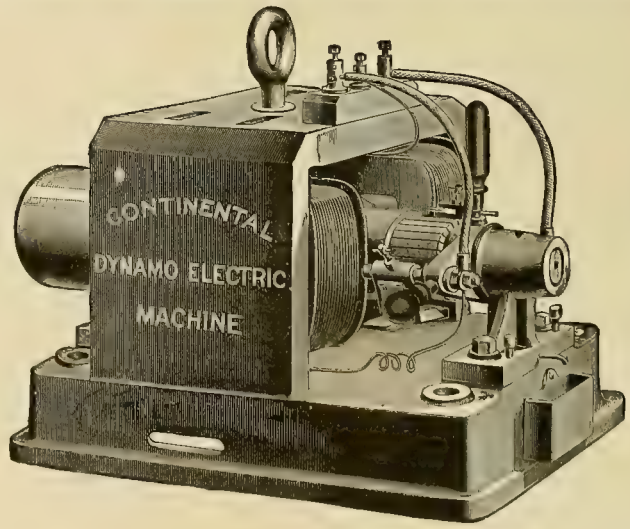

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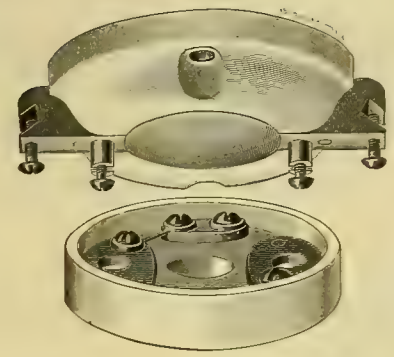

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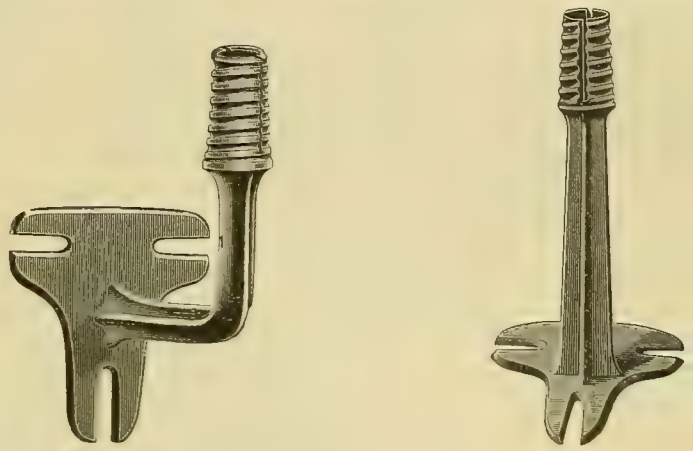

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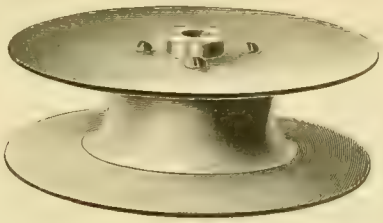

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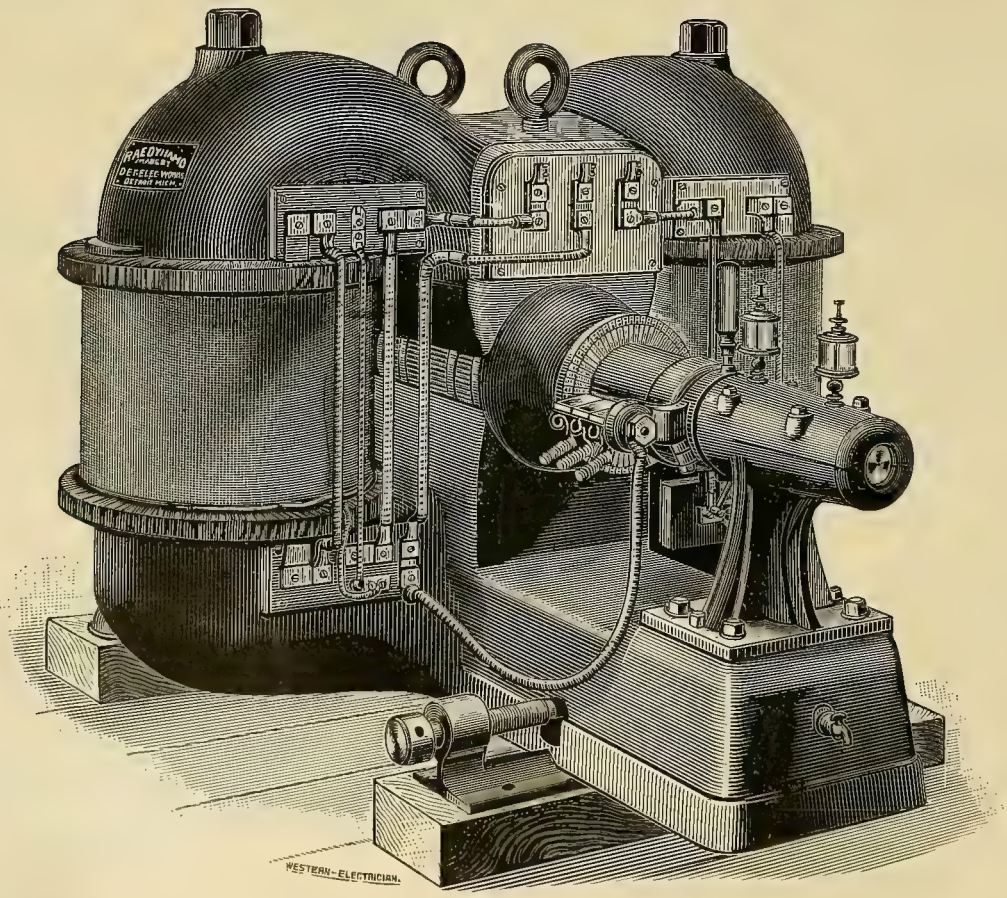

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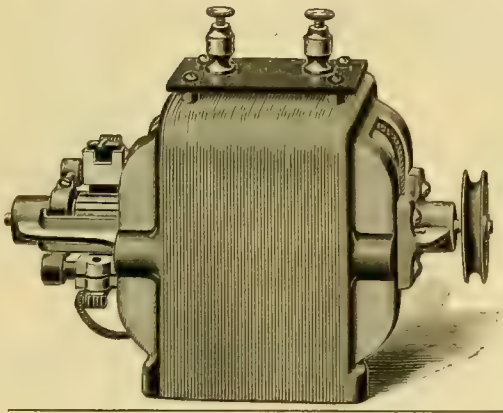

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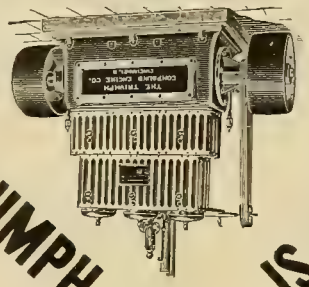

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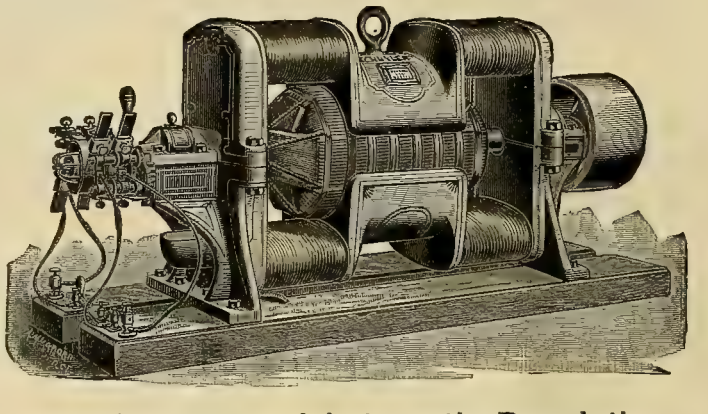

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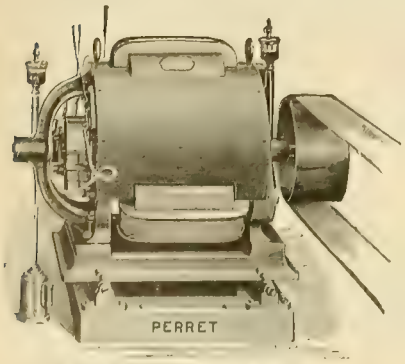

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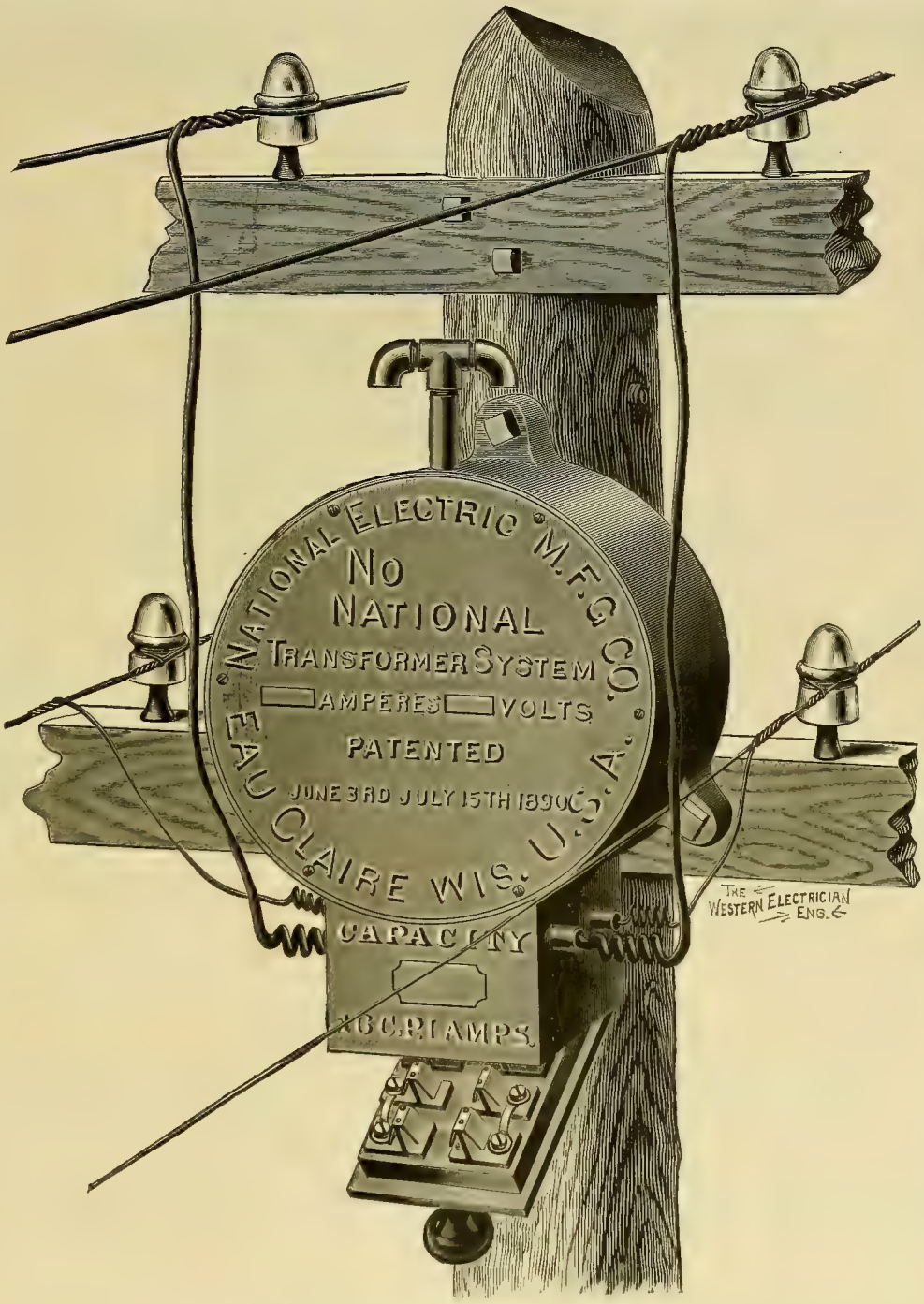

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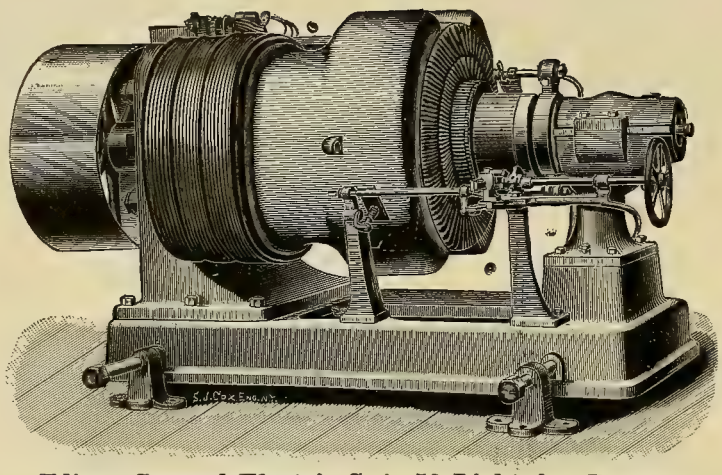

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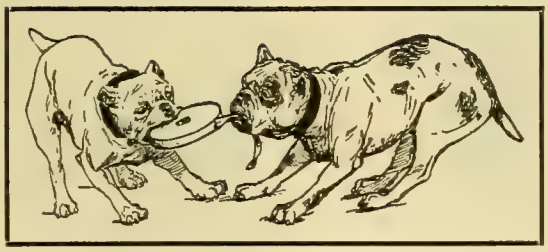

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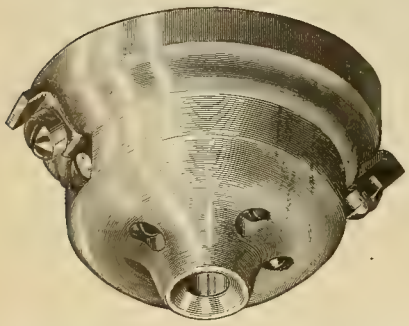

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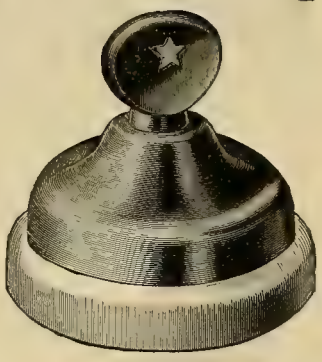

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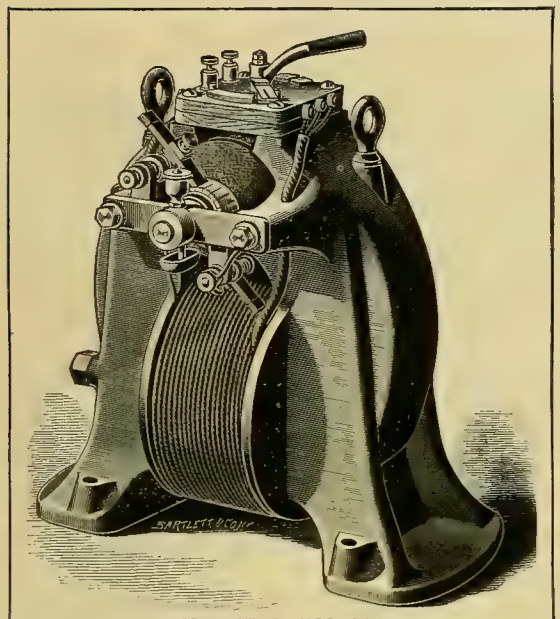

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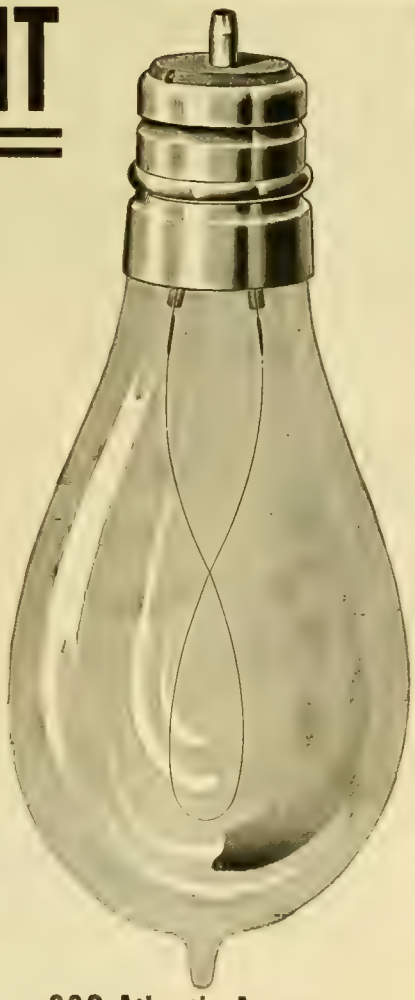

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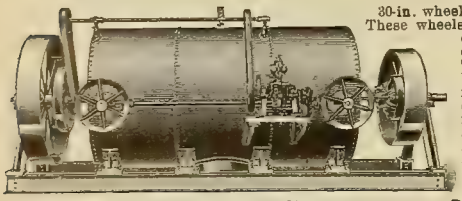

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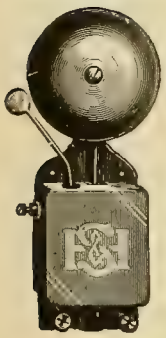

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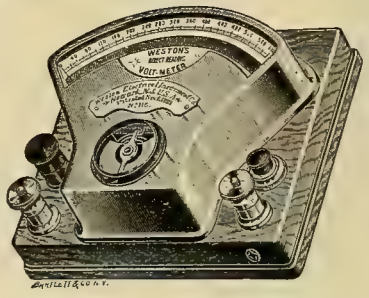

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ALUMINUM BRONZE

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Castings, Ingots, Sheets, Rods and Wire.

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WANTED A position as manager or Superintendent of Central Lighting Station, by one familiar with all departments of Central Station and Construction work. Proof furnished if necessary. Location no object if it be permanent. Address **T. H.,** Care WESTERN ELECTRICIAN, Chicago.

The Electrical Commissioners of the District of Columbia invite communications from firms interested in electric cables, conduits, subways, etc. Also, upon the subject of municipal electric lighting, electric transmission of power, etc. Communications received until March 1, 1891. Personal interviews cannot be granted at present. Address, Electrical Commission, Room 30, District Bldg., Washington, D. C.

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95 CHAMBERS STREET, NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. VIII. CHICAGO, FEBRUARY 14, 1891. No. 7

John P. Barrett, Chief Electrician, World's Columbian Exposition.

The long looked for appointment of chief electrician of the World's Columbian Exposition was made last week, and John P. Barrett, city electrician of Chicago, secured the prize. Prof. Barrett's name was presented by his friends about eight months ago, and the universal approval with which it was received by the electrical fraternity throughout the country made his selection for the position an assured fact. He has in fact been the only candidate seriously considered. The failure of the director general to make the appointment earlier occasioned considerable comment, but now that the selection has been made, and the wishes of the fraternity have been considered, the enthusiasm is becoming manifest in many ways.

Prof. Barrett is a familiar figure in Chicago, and the excellent portrait herewith presented, will call him at once to mind. He is generally esteemed, and is probably one of the best known men identified with the electrical interests to-day. This latter fact is no doubt due in a large measure to the fact that he has earnestly advocated the burying of electric wires in large cities, and has demonstrated the practicability of the underground system. The prominence which Chicago has attained in electrical circles the world over is due in a large measure to its underground system of electric lighting, which was introduced through the efforts of Prof. Barrett, who is, of course, proud of the success which has attended its operation. It is not, however, solely in the electric lighting field that Prof. Barrett has gained distinction and reaped golden rewards. In nearly every city of the country devices invented or improved by Prof. Barrett are used in connection with the fire alarm and police telegraph systems. He is a thoroughly practical man, and as he has demonstrated to his own satisfaction that electric wires can be operated in subways, he believes in underground conduits, and advocates the burying of wires in other large cities, wherever his advice is sought. He is outspoken in his views, especially on all public matters and independence has been a prominent feature in his character. This may be attributed to his experience in early life, a sketch of which will prove interesting.

Born near Auburn, N. Y., in 1837, he removed with his parents to Chicago, when only seven years of age. It was not his privilege to enjoy an extended education, though he was fond of books, and made excellent use of his time at school. At the age of twelve years he went to sea, entering as a ship's boy, and rising to the position of an able seaman. In a storm off the coast of Chili he met with an accident, which, it was feared, would cost him his life. He was flung from a masthead and crippled for life. Two other sailors who were with him were killed, but after nearly two years' suffering in a San Francisco hospital, Prof. Barrett regained his health, returning to his home in Chicago in 1865. This was the turning point in his life. Shortly after his arrival he was appointed fire watchman in the glass tower on the city hall, which commanded a view of every housetop in the city, and it was his duty to sound the alarm at the first indication of a conflagration. This was his first public service. It proved satisfactory, and he has since discharged his duties most conscientiously. The fire department of the city of Chicago has been greatly benefited by his connection with it. In fact, the whole world is indebted to him for developing the fire alarm telegraph system which is now in general use.

The accident which unfitted him for following his original occupation gave him an opportunity to prepare himself for his new field of labor. During his confinement at the San Francisco hospital he studied diligently, and made remarkable improvement. He continued his studies while in the service of the city, and when his faithful performance of duty had won

JOHN P. BARRETT.

the confidence of his superiors he was prepared to perform the duties of a higher office, the promotion to which his intelligent service had entitled him. When the fire department was organized on the metropolitan system and telegraphy was employed as the means of communication between engine houses, Chief U. P. Harris appointed Prof. Barrett battery man and assistant operator. Despite the objections of the fire commissioners to his appointment, because of Prof. Barrett's inability to operate, he was retained upon Harris' recommendation, and the latter's belief in his protege's ability to master the business. This confidence was not misplaced. Prof. Barrett studiously applied himself to the duties of his new position, and not only became an expert operator, but continued his studies and experiments, introduced new ideas, suggested many improvements, and soon became recognized as the authority of the office. In those days practical electricity was in its infancy, and Prof. Barrett succeeded in improving the service materially. When he was appointed chief of the electrical branch of the city service he was given a better opportunity to put his ideas into practice and conduct his experiments on a more extensive scale. The entire fire alarm service was remodeled, and the new chief's ideas introduced. The box system was first revised, and much time was saved by the improvements in roduced. For instance, a device which Prof. Barrett termed a "joker" was utilized, by which the alarms are received in the engine houses simultaneously with their arrival at the central station, the horses are released, and the firemen notified that their services are required. With the growth of the city came new obstacles, but these were overcome as they presented themselves. It became necessary to employ a device by which only those companies whose services were required might be called out. For this purpose Prof. Barrett introduced his still switch which serves the purpose admirably.

But the fire alarm system did not employ all his attention. He devoted himself to the police patrol system, the underground telegraph system, the bridge telephone system, the scheme of lighting the river by electricity, and numerous others. His ideas have been copied throughout the United States and Europe, and the electricians of the world made pilgrimages to Chicago to study the minutiæ of his department. He is still on the march onward, and is now projecting a scheme by which all the bridges will be opened and closed by electric power from the main station in the city hall. The establishment of a factory for the manufacture of all electrical supplies for the municipality is also receiving a large amount of his attention. This has already been begun in a small way.

All of his numerous inventions and achievements however, are insignificant in his own estimation in comparison with the system of electric lighting which he has introduced into Chicago. It was a great project, and involved more than may be realized at first thought. For years the people had been clamoring for electric light. Chicago saw her sister cities brilliantly illuminated, while her streets were poorly lighted by gas and oil.

To all the demands for electric light Prof. Barrett turned a deaf ear until he was satisfied he had solved the problem. Before introducing his system he caused the removal of poles and wires from the streets, and in this movement Chicago led the world. To-day its streets are no longer disfigured by unsightly poles and a network of wires, and no one in Chicago will question the statement that the city is improved in every respect by the change. The foundation for an extensive system of public lighting has been established. The plant will be enlarged each year until the entire city is lighted by electricity. The features of this system are familiar to readers of the WESTERN ELECTRICIAN.

No doubt the prominence Prof. Barrett gained in the controversy over the solution of the underground question and the persistence with which he opposed overhead wires, has assisted him materially in securing the appointment. Undoubtedly the same independence of character which has characterized his official career will be seen in his administration of the office to which he has been appointed. He enters the office unpledged and actuated only by a desire to promote the interests of the electrical industries.

In conversation with a representative of the WESTERN ELECTRICIAN, after his appointment, Prof. Barrett said: "As yet I do not know anything about the work already done. I do not know that anything has yet been done, but I shall at once take steps to organize this department."

Prof. Barrett's ideas were presented in detail on several important points in his paper before the National Electric Light association convention last summer at Cape May. This paper was published at the time in the WESTERN ELECTRICIAN, and attracted considerable attention.

Prof. Barrett will attend the convention of the National Electric Light association at Providence, February 17, 18 and 19. He will have an opportunity to meet manufacturers from all parts of the country, who will doubtless assure him of their willingness to co-operate with him.

National Electric Light Association.

According to every indication the convention of the National Electric Light association at Providence will be of unusual interest. The list of papers for the meeting includes the following:

How can the National Electric Light Association best serve Central Station Interests? By C. R. Huntley.

Distribution of Steam from a Central Station. By F. H. Prentiss.

Distribution and Care of Alternating Currents. By T. Carpenter Smith.

Municipal Control of Electric Railroads. By M. W. Mead.

The Ferranti System. By C. B. Haskins.

Electric Lighting as Applied to Steam Railroads. By W. H. Markland.

The Electric Arc and its Use in Lighting. By Prof. Elihu Thomson.

Prof. Thomson writes as follows: "I shall endeavor to make the paper an outline of the characters of the arc scientifically considered, the characters of dynamo machines which are useful for arc lighting, the desirable features in arc lamps, and the difference in their workings."

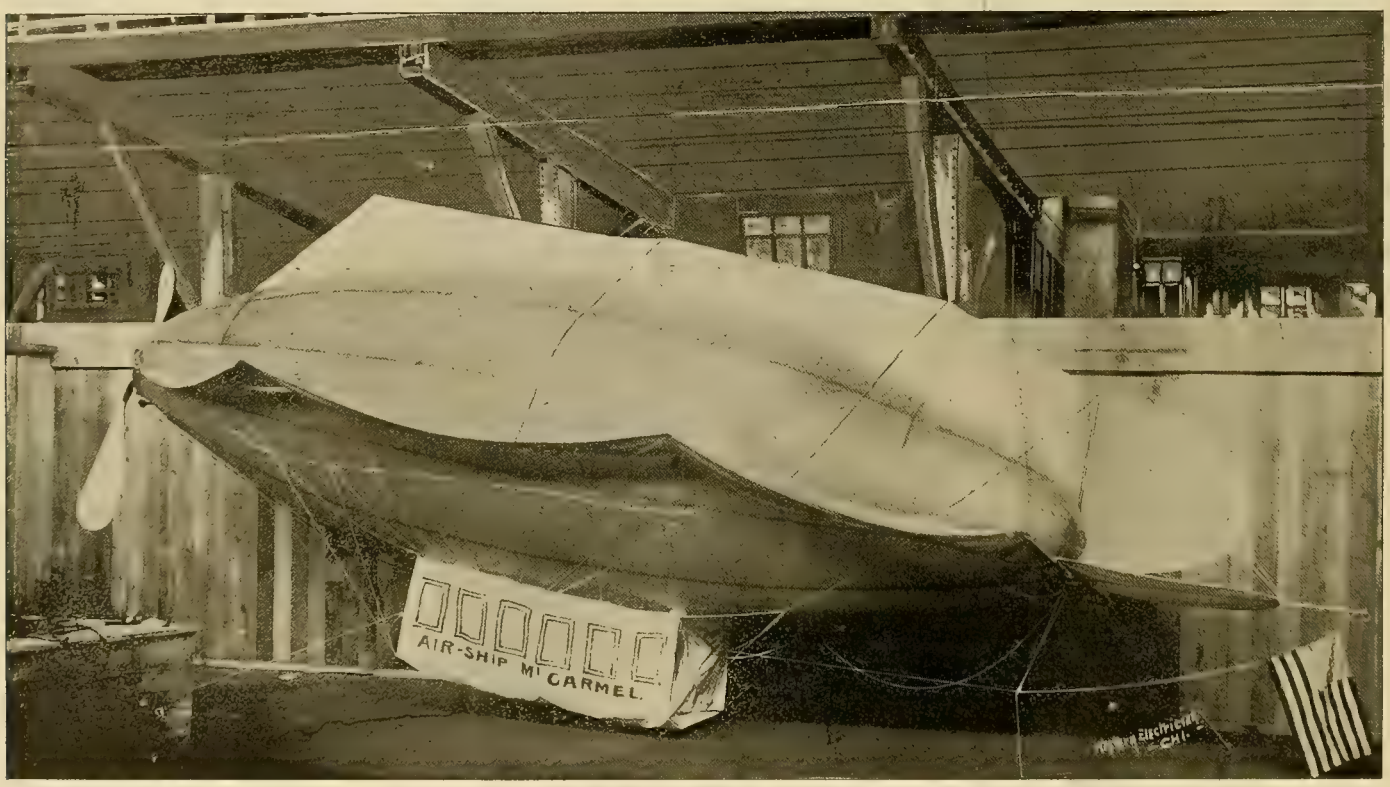
The second day of the convention will be devoted to a celebration of the close of the first decennial of electric lighting. In the evening President Marsden J. Perry will give a reception at Spink's Assembly rooms.

Among the places of interest in Providence, which members of the association are invited to visit are the following: Factory of the Brown & Sharpe Manufacturing company, factory of the American Screw company, factory of the Gorham Manufacturing company, Narragansett Electric Light Station, Rhode Island Locomotive Works, works of the New England Butt company, factory of the Armington & Sims Engine company, and American Electrical Works.

Pennington's Air Ship.

The readers of the Chicago daily papers have, doubtless, had their curiosity aroused by the various accounts—favorable and unfavorable—of the Mt. Carmel air ship, which is now on exhibition in the Exposition building, Chicago.

During the several weeks before E. J. Pennington, the inventor of the device, succeeded in his attempts to float his model ship, the press "filled space" with unfavorable comments, and one journal went so far as to insinuate that the delay of the arrival of the ship at the Exposition building had been caused by a premature ascension in which the railway train and all had been carried up and lost in space. However, the ship flies, and has been flying for some time. Within the walls of the Exposition building the air ship makes its daily trips, and all skeptics have now an opportunity to judge for themselves whether the problem of aerial navigation has been solved.



PENNINGTON'S AIR SHIP.

With the view of giving the readers of the WESTERN ELECTRICIAN, who have not the opportunity to make a personal inspection, a correct idea of the construction of the air ship, there is presented herewith an engraving reproduced from a photograph of the model as it appears at its moorings in the Exposition building.

The length of the flying machine is thirty feet over all. The main or gas-containing portion which, to all appearances, is made of silk, or a material very similar, is twenty-four feet long. The propeller from tip to tip of its two blades measures six feet, and is carried in front of the vessel. With the aid of the cut and these measurements the general proportions of the ship may be very nearly approximated.

The gas for floating the device is hydrogen, and the motive power is electricity. An Edco motor, said to be of a capacity of only 1-32-horse power, is contained in the canvas car marked "Air Ship Mt. Carmel." This motor runs at eight hundred revolutions per minute, and is geared by means of cord and cog wheels so as to drive the propeller at seventy revolutions per minute.

When in the air the vessel carries only the motor, the current being fed to it through a conducting cable leading down to six Accumulator company's cells on the ground. It is said that the model has been run at a speed of fourteen miles per hour in the Exposition building.

Chicago Telegraphers' Ball.

The annual ball of the Chicago telegraphers was held at the Second Regiment armory, Michigan avenue, Friday evening, Feb. 6. About 250 couples were in the grand march and there were many more in the galleries. A large number of out-of-town telegraphers and their friends were present, St. Louis, Milwaukee, Columbus, Toledo, San Francisco, St. Paul, Quincy, Sioux City, Oshkosh and other cities being represented. Prof. J. P. Barrett, city electrician of Chicago, was a prominent figure, and he received congratulations from his old friends upon his appointment as chief electrician of the World's Columbian Exposition.

During the evening congratulatory messages were exchanged between the operators in New York, Boston and Chicago, and all seemed to thoroughly enjoy the reunion. The occasion was of special significance as it was the first time the telegraphers have gathered socially since the great strike of 1883. Last week's reunion was a most harmonious gathering, and all were pleased with the new turn of affairs. When "30" was given it was accompanied with the hope that all might enjoy another reunion a year hence.

The committee of arrangement was composed of the following named gentlemen, all of whom worked assiduously to promote the success of the affair: N. M. Kent, Joseph Laird, F. M. Crittenton, J. S. McCurdy, B. F. Maloney, F. T. Mullen, W. A. Dillon, J. J. Burke, W. H. Mills, John Savoy, C. H. Finley.

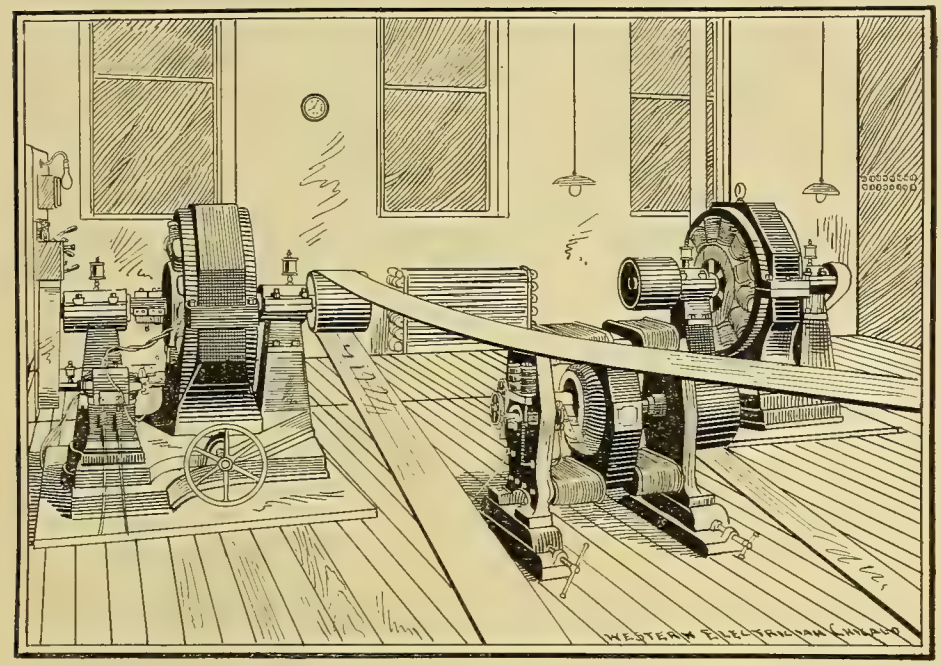
Transportation to the Providence Convention.

Special rates have been secured over all the roads for delegates from Chicago to the National Electric Light association convention at Providence, R. I. The usual convention rate of one fare and a third has been secured. It is expected a large Western delegation will be in attendance.

C. H. Barney, chairman of the committee on transportation, announces for the benefit of Eastern delegates that arrangements have been made for a train of parlor buffet cars to leave the Grand Central depot, New York, Monday, Feb. 16, at one P. M., arriving in Providence at 6:15 P. M. The rate secured is $5.74. An extra charge of $1.00 is made for seats in parlor cars.

South Side Electric Light Company's Plant.

The central station alternating current plant, illustrated in the accompanying cut, was installed by the South Side Electric Light company at State and Twentieth streets, Chicago, to furnish current to the Alhambra theater and the business blocks in the neighborhood. As will be seen by reference to the illustration two alternating current machines of the Slattery type, manufactured by the Fort Wayne Jenney company, and a 25-light arc machine of the Wood type, comprise the generating plant. Two 100 horse power Bass engines, belted direct, drive these machines.



SOUTH SIDE ELECTRIC LIGHT COMPANY'S PLANT.

Current is supplied to the Alhambra theater which is illuminated by 1,100 incandescent lamps of 16 to 150-candle power. The hotel, offices and stores occupying the remainder of the block in which the theater is located are also lighted from this station, 900 incandescent lamps being used.

It is the intention of the company to install a much larger plant. It is proposed to have a battery of eight boilers, aggregating 2,000-horse power, three 450-horse power compound engines, ten alternating current machines of 1,000 lights' capacity each. The Fort Wayne Jenney company is building these machines now. The plant is in charge of W. H. Harding, manager of the company.

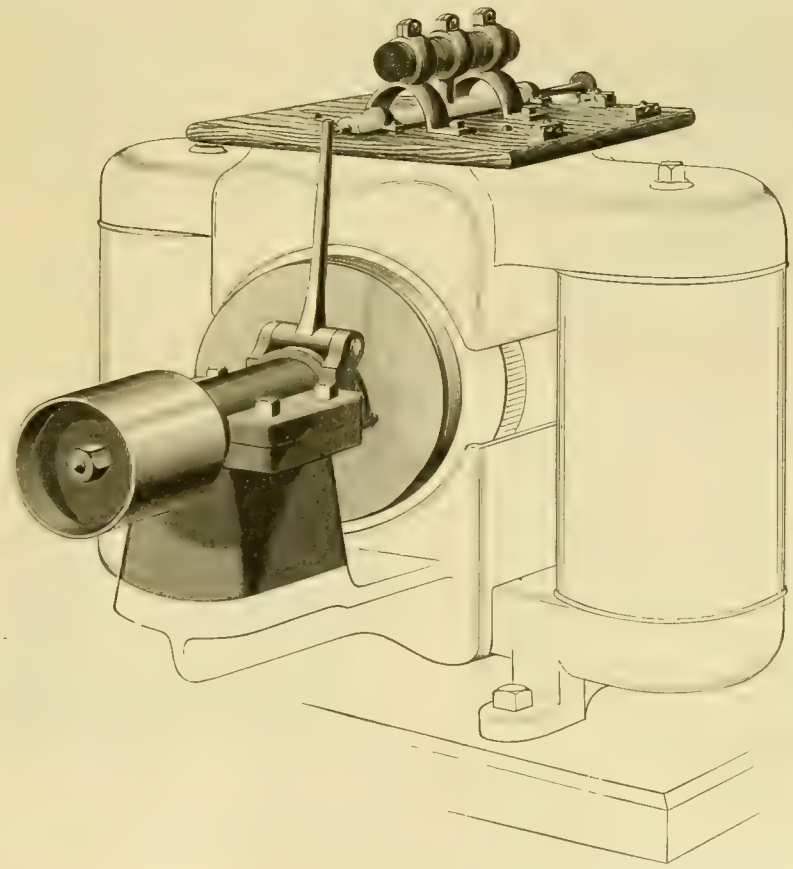
Electric Subway Question in St. Louis.

The city council, mayor and electric companies of St. Louis are engaged in a controversy over the question of disposing of electric wires. There seems to be a desire to take the matter entirely out of the hands of the city council, but that body does not relish the prospect, and has entered a vigorous protest. At the last meeting of the council the following resolution was adopted: "That the Senate and House of Representatives of the State be requested not to pass substitute for Senate bill No. 3. Said substitute will seriously affect the introduction of new telegraph and telephone service and private lines, and tend to the continuance of a monopoly in the telephone service upon the eve of the expiration of the telephone patents, because new companies could not undertake the great expense of separate conduits. It will be ineffectual in its purpose, because it exempts street car and electric light wires, the most dangerous and unsightly of all. It gives undue power to the executive department of the city, and sets a dangerous precedent for direct appeals to the legislature in behalf of special interests. It is special in its character, having reference to St. Louis alone, and is therefore contrary to the spirit of the constitution. A public conduit, equally accessible to all users, is the only proper method of disposing of overhead wires, and any attempt to dispose of them is useless until it can reasonably include all such wires. We recommend the passage of a law giving to all cities of the first class the right to control electric wires through their own local government."

It is believed this controversy will eventually dispose of the attempt to bury the wires in St. Louis.

The Card Arc Motor.

The accompanying cut illustrates the improved type of constant current motor now being manufactured by the Card Electric Motor & Dynamo company of Cincinnati, O. This motor is a governing machine. A centrifugal governor is so attached to the armature and arranged with reference to the field coils, that a practically constant speed can be maintained. An increase in speed causes the field magnetizing coils to be opened and the circuit completed through the armature, thus reducing the speed of the motor. As the speed decreases the field magnetizing coils are again in series with the armature. By simply turning a hard rubber button the speed of the motor can be adjusted to 500 revolutions per minute slower or faster than the regular speed.



CARD ARC MOTOR.

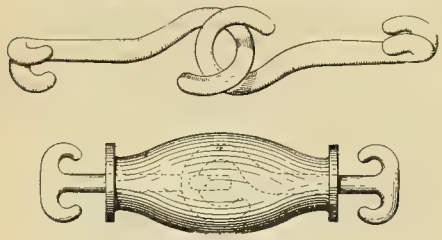
Chicago Electric Club and the World's Fair.

The interest manifested by the Chicago Electric Club in the World's Columbian Exposition was clearly shown by the attendance at the special meeting of the club last week. The notice given the members was of necessity very short, yet the response was so general that every electrical industry was represented. President Beach who had just returned to the city after an absence of three months, took occasion to renew his acquaintance with the members and participate in the proceedings of the club. In calling the meeting to order the president expressed his interest in the World's Fair and called attention to the general public interest in electrical matters pertaining to the exposition. He called upon B. E. Sunny, chairman of the general committee on World's Fair matters to explain the special business before the club.

The committee has been engaged since its appointment in securing information that will prove valuable to the commissioners in their preparation for the electrical exhibit. It appears to be the general belief that the intention of the World's Fair authorities is to divide the electrical exhibit, placing the heavy machinery at Jackson Park and the remainder on the Lake Front. The object in doing this it would appear is to draw the crowds to the Lake Front in the evening and perhaps increase the gate receipts. The fact that the Jackson Park portion of the fair would be open in the evening, removes the only objection that could be raised to the location of the entire electrical exhibition there. The committee desired to get an expression of opinion from the club on this point and the meeting was accordingly called to discuss this and other questions pertaining to the electrical section of the World's Fair. F. W. Parker suggested that the club appoint a committee to wait upon the World's Fair commissioners and present an address in which the sentiment of the club should be expressed. He said he did not believe the commissioners

realized the magnitude which the electrical exhibit would assume. It would be the crowning feature of the exposition, he ventured to say, and the representatives of electrical interests should insist that it be not slighted or run as a "side show."

The discussion became general and it soon appeared that there was a unanimity of opinion to the effect that the electrical exhibit should be made in one place and that Jackson Park afforded the best facilities for making the exhibit. The question was accordingly referred to a committee composed of Messrs. Cushing, Terry, Kreidler and Parker, and it prepared an address and resolutions which were afterward approved by the club. The committee was instructed to present the resolutions to the officials and urge upon them the necessity of considering and adopting the suggestions of the club. Mr. Sunny said the objection had been raised that the electrical exhibit if located at Jackson Park would not be seen by the people at night. He believed more people would go to Jackson Park to see it than if it were held on the Lake Front. They would be glad to get away from the heat of the city. Moreover, the display at Jackson Park could be made upon a far more extensive scale than the Lake Front would provide. The objection to smoke was urged as another reason why the Lake Front was not the place for the electrical display. It was conceded that all of the electrical apparatus could not be exhibited on the Lake Front if for no other reason than lack of power. The question of securing ample power was not to be thought of. In order to illustrate the general interest that is felt in electrical apparatus Mr. Sunny called attention to the fact that the exhibit made in Chicago by the National Electric Light association two years ago, was attended by more than 100,000 persons



LOOP INSULATING DEVICE.

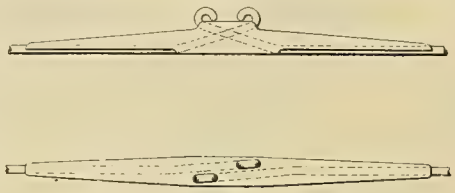
in five days. This exhibit was gotten up hurriedly—in fact within thirty days—and the weather was intensely cold, yet the people crowded the building and many stood in the streets for hours unable to gain admission. "If this can be said of the little exhibit we gave at that time," said Mr. Sunny, "and it was comparatively small, what may we expect in '93 when the whole world will be represented. It is not too much to say the electrical department will occupy the greater part of the public interest."

Mr. Cushing suggested that in addition to the work of the committee each member make it a point to personally agitate the question of securing additional space and a united exhibit. He called attention to the fact that other exhibitions in this country and Europe had devoted far more space to the electrical department than that proposed in the Columbian Exposition. The same idea was elaborated upon by George Cutter, Thos. G. Grier, G. A. E. Kohler and F. A. Sargent. The latter gentleman called attention to the fact that the smoke nuisance in the business portion of the city was now a question of great public importance and he doubted very much if the city would allow the construction of a plant on the Lake Front for 10,000 to 25,000 horse power.

Lieutenant F. B. Badt said that 11,000 horse power would be required for lighting purposes only, if the exhibits were gathered at Jackson Park. The secretary read a letter from Prof. Barrett, in which he thanked the members of the club for the active part they had taken in promoting his canvass for the position of electrician-in-chief of the World's Fair. He expressed an earnest desire to have the co-operation of the committee, and announced his willingness to meet the committee at any time for consultation.

Short's Trolley Wire Coupling.

The illustration presented herewith represents a coupling made of cast metal. Each arm of the connector has taper ends, and is provided on its under side with a groove for the reception of the two adjacent ends of the trolley wire. The ends of the trolley wire pass upwardly through inclined holes, which extend through the connector and in different planes, as is indicated in the lower figure in the cut. A loop or bend formed at the ends of the wires secures the coupling in place. The lower surfaces of the trolley wires, together with the straight surface on the under side of the central portion of the



SHORT'S TROLLEY WIRE COUPLING.

connector, constitute a smooth and uninterrupted bearing surface for the passage of the trolley. It is intended that slack in the wire shall be readily taken up by drawing the wire through the holes in the coupling, and forming a new bend on the projecting ends. This device is the invention of Sidney H. Short of Cleveland, O.

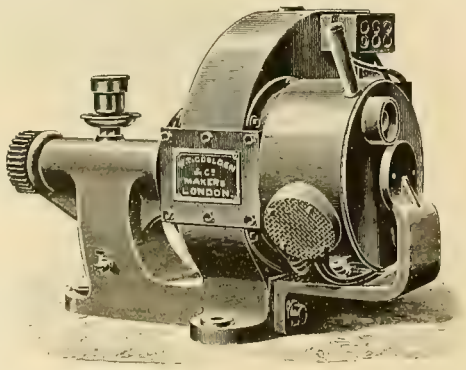
Loop Insulating Device.

The accompanying cuts illustrate the main features of a number of forms of insulators recently devised by H. D. Winton of Wellesley, Mass. The fixture is so simple and so clearly illustrated that but few words are necessary in explanation of its construction.

Two metallic hooks, cross-heads or their equivalents, are moulded or cast within insulating material, as shown. The interlink of the separated hooks in the body of the insulating substance gives the device strength and stability. One of the features claimed for this type of insulator is that should the insulating material crush, or give way in any manner, the hooks or cross-heads would not fall apart, but would cling together and cause only the temporary interruption of the current from its intended course.

English Mining Motor.

One of the principal difficulties likely to occur in connection with mining work is the very rough conditions and dirty situations in which the motors have to be used, and a further difficulty in coal mines is the danger that occasionally arises from the presence of explosive gases. For ordinary purposes, in coal mines, it may be safely assumed that the motor will not be working in an explosive atmosphere, and it is, there-



ENGLISH MINING MOTOR.

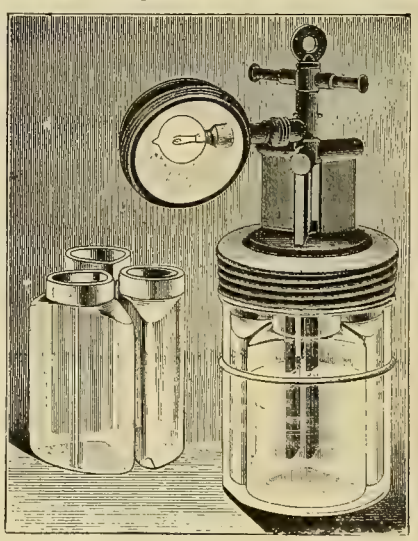
fore, sufficient to carry out the arrangement of inclosing the whole armature and brushes in air-tight and dirt-tight coverings. These coverings are sufficient to exclude an explosive mixture for many hours, and before such a mixture finds its way into the neighborhood of the brushes the condition of the atmosphere will have been noted by the attendant, and the current cut off.

The illustration shows one form of mining motor manufactured by W. T. Goolden & Co. of England, in which the complete inclosing of the armature is one of several features.

The construction of the armature of this machine is unusually strong. The wi es are keyed in every position and insulated from the core and from one another by means of mica. The inclosure of the armature was supposed at one time by some to be impossible, on the ground of the necessity of ventilation, but motors working up to 30 or 4 -horse power with such inclosed armatures, have been used, it is stated, very satisfactorily for some time. In cases where it is desired to make a machine absolutely safe in an explosive mixture, Messrs. Goolden employ an arrangement in which the volume of gas inclosed in the cover of the brushes and commutator is as small, or less, than that inclosed in an ordinary safety lamp. Should ignition result therefore, the volume of gas compared with the length and cooling surface of the outlet, it is stated, is such that no flame will appear externally.

Electric Lamp for Photographers.

As an oil lamp is for many reasons an exceedingly undesirable adjunct in a photographer's dark room the apparatus shown in the cut has been designed as a substitute. It consists of a small, 5-volt incandescent lamp arranged behind a colored glass shade, and in front of a reflector. Current is furnished by a battery of three bichromate cells arranged as shown in the cut. The arrangement is such that the zincs



ELECTRIC LAMP FOR PHOTOGRAPHERS.

can readily be lowered into the solution, and as quickly withdrawn. The reflector is so made that it can be moved in any direction so that the rays can be turned on any desired object. The cut is reproduced from *La Nature*.

The Book Table.

THE ELECTRO MAGNET by Silvanus P. Thomson. Authorized American Edition, 280 pp., 66 illustrations. Published by the W. J. Johnston company, limited, New York.

This volume contains the four lectures delivered by Prof. Thomson before the Society of Arts in February, 1890. It is undoubtedly a work which every electrician will want to add to his reference library. The book is written in the clear style which makes all of Prof. Thomson's works prized by the student. The book is a comprehensive volume. The author begins his historical sketch with a description of the work of Sturgeon, who announced his discovery of the electro-magnet in a paper contributed in 1825 to the Society of Arts. It is an interesting fact that Sturgeon's paper and Prof. Thomson's lecture were read from the same platform. In his introduction it is stated that the course of lectures was delivered for the purpose of showing how the same considerations which have been applied with such great success to the subject of the design of dynamo electric machines may be applied to the study of the electro-magnet. The theory of the design and construction of the electro-magnet, the author says, will thus be placed upon a rational basis. How well the author has accomplished

his task cannot be determined by the casual perusal which it has been possible for the writer to give to the book in the short time in which the book has been before him. It is safe to say, however, that the treatment of the subject is admirable, and that the reader who consults it will not find it wanting. A general idea of the plan which he follows is given in the introduction, and to the analysis Prof. Thomson closely adheres. After the historical sketch the uses and forms of electro-magnets are considered. Magnetic properties of iron and steel are discussed, and a description of the methods employed for ascertaining magnetic permeability is presented. After touching upon magnetic hysteresis, the author discusses the magnetic circuit and the law of traction between the electro-magnet and its armature. The rules for calculating the windings are given, after which is presented a detailed discussion of the varieties of form to be given to electro-magnets to adapt them to particular kinds of work. In

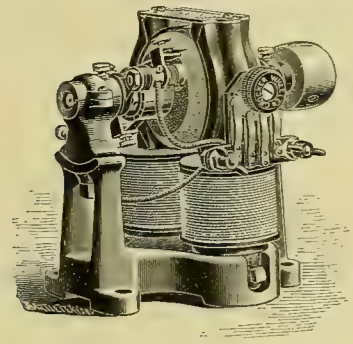


FIG. 1. CROCKER-WHEELER SMALL MOTOR.

conclusion the author gives some account of the varied forms of electro-magnetic mechanism which have been devised.

Crocker-Wheeler Small Motor.

The small Crocker-Wheeler machines are made on precisely the same plan as the large sizes. They are provided therefore, with wrought iron field cores set into the base, movable rocker arm, starting switch, armature wire embedded in iron for protection, self-oiling babbitted or bronze bearings, etc.

The one-sixth-horse power motor, Fig. 1, is provided with self-oiling bearings of the same type as used on the larger sizes. The speed of this machine is 1,700; its weight is twenty-six pounds; its height is nine and one-half inches. The one-sixth-horse power motor will raise, it is stated, two and one-half tons, one foot in a minute, and will pump eighty gallons of water

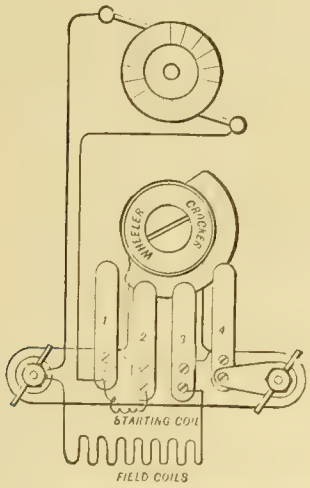


FIG. 3. CROCKER-WHEELER SMALL MOTOR.

one hundred feet high in an hour. It is recommended for driving 16-inch fans and "double enders," or in cases where a small motor is to be wound to order for extremely slow speed.

The one-eighth-horse power machine has self-centering pillow blocks with bushings of the best babbit for bearings. The speed of this machine is 1,900 revolutions. It will do, it is stated, 4,000 foot-pounds work per minute, and is used for ordinary fan work, running single sewing machines, and for other light work where a self-oiling bearing is not wanted.

The one-twelfth-horse power has self-centering pillow blocks and bearings of the best bronze, and is used for furnishing power from primary batteries, for dental outfits, etc., etc. This size

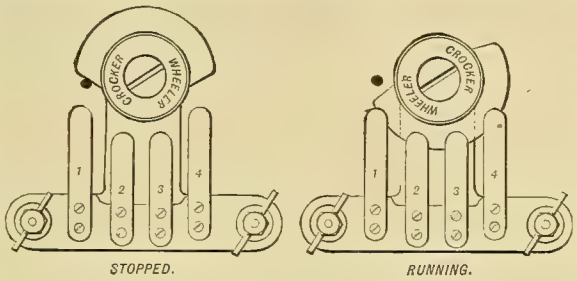


FIG. 2. CROCKER-WHEELER SMALL MOTOR.

is made with a high pedestal as in the regular electric fan combinations.

The small motors are all fitted with switches for starting and stopping, and in some cases for regulating. The constant speed motors have the style of switch shown in Fig. 2. This switch, when turned first, charges the field, then starts the armature through a resistance wound on the machine, and finally starts the armature at full power. The arrangement of connections is shown in Fig. 3.

A new style of winding on the Crocker-Wheeler machines takes the place of the lamp frequently used on the top of motors to vary the speed. This change is an improvement in that it saves the current usually wasted on the lamp and gives a means of instantly changing the motor's speed by turning the knob, without the use of resistance boxes or the trouble of unscrewing and removing a lamp.

The Crocker-Wheeler motors made adjustable as to speed and power, are especially suited for running fans, as it is very convenient at times to change from fast to slow speed by simply turning a knob. The windings of this type are so proportioned, it is stated, that in either case the motors run at the respective speeds with high efficiency.

The construction of the Crocker-Wheeler motors has been improved to permit the use of wire on the armature two sizes larger than has heretofore been possible, thereby making the winding much less liable to breakage, and enabling it to carry more current without heating. The efficiency of the machines, it is claimed, has again been increased materially. The bases are made extra strong, with the center of gravity low to add to the steadiness and solidity of the machines. The direction of rotation is made reversible by simply changing the brush holders. The machines are manufactured by the Crocker-Wheeler Motor company of New York.

The cold weather has delayed the progress of the Paris-London telephone line, and the service will consequently not be begun until the first of March. The 15th of February is the date fixed for the submersion of the cable, and the official trials will last until the end of the month. The tariff has been fixed at 10 francs for three minutes' use of the telephone. It is said that the new telephone will be formally inaugurated by Queen Victoria and M. Carnot, who will exchange greetings over its wires.

Electrical Reporting of Races and Games.

The device illustrated by the accompanying cuts was designed to indicate at a distant point the progress of races, games, etc. In the present instance a horse race is represented. The represents an ornamental dial showing the relative positions of horses in a race from start to finish. A bulletin card is supplied with the day's entries, and when so supplied will indicate any race when connected by wire with the track. The horses' names are generally printed in colors to correspond with dummies on the dial. Upon the entry card may also appear any information, such as that in regard to sweepstakes, handicaps, the purses, etc. The dummies are colored, so that in each race identification is complete. When the race starts a bell is tapped to attract attention. The horses come in their proper order, stop on the scratch, ready for the next race. The advantage of this system from an economic standpoint is that no re-

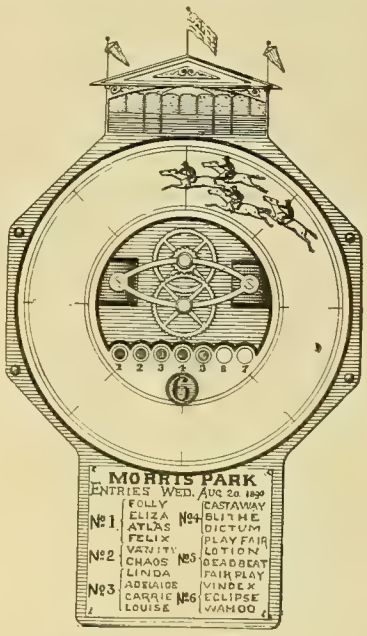


FIG. 1. ELECTRICAL REPORTING OF RACES AND GAMES.

ceiving operator is necessary, the dials receive and publish the event at one and the same operation. In comparison with the stock "tickers" it is claimed to be very much cheaper to make,

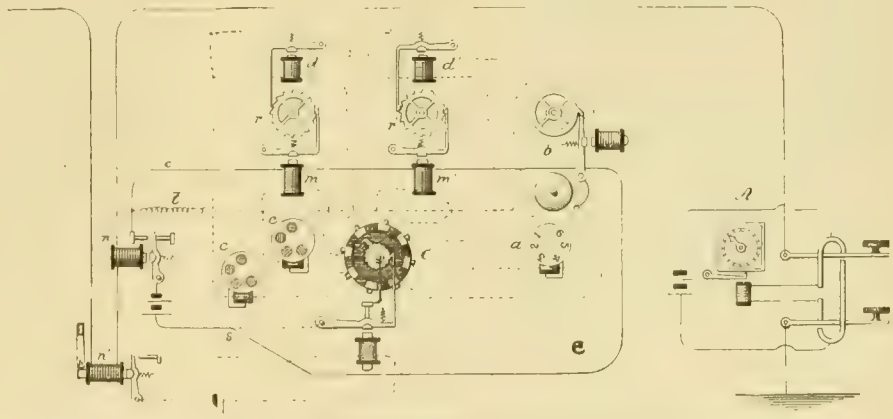


FIG. 2. ELECTRICAL REPORTING OF RACES AND GAMES.

and it is not so liable to derangement. It can be worked, it is asserted, over single line circuits to greater distance than any ticker. The fact that it may be "relayed" over long lines is emphasized as an important point.

The transmitting portion of the apparatus is shown at *A*, Fig. 2. The connections of the receiving device may be traced out in the same diagram.

The California legislature has not yet amended the law granting electric companies the right to operate in that state. There are roads in operation, however.

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W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - } Associate Editors.
J. B. O'HARA, - - - - - - - - - - }
F. L. PERRY, - - - - - - - - - - }
A. C. DURBOROW, JR., - - - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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IT speaks well for the excellence of the construction work on electric railways that the recent blizzards which have played such havoc with wires have not, with a few exceptions, damaged the railway circuits.

ACCORDING to all reports there will be an unusually large attendance at the meeting of the National Electric Light association at Providence, Feb. 17, 18 and 19, and the convention will be one of marked interest. The programme, as at present arranged, is given in another column.

PROF. BARRETT, the recently appointed chief of the department of electricity of the World's Columbian Exposition, will attend the convention of the National Electric Light association at Providence next week. Members of the organization have entertained conflicting opinions in regard to matters relating to the exposition; but inasmuch as there are no longer questions at issue, we do not doubt that they all are now ready to do everything in their power to advance the interests of the electrical section. Prof. Barrett will be afforded an opportunity to meet representatives of electrical companies from all over the country, who will doubtless assure him of their hearty co operation, and give him the benefit of such suggestions as may occur to them.

THE legislature, according to our Minneapolis correspondent, is disposed to treat the street car companies operating in the Twin cities rather unfairly. While it is investing an enormous amount in the electrical equipment of the road, and the improvement of the service the senate is considering the advisability of materially reducing its income. The legislature, however, in all probability will not be unwise enough to pass the measure referred to in the Minneapolis letter.

IN this issue is presented a description of an air ship now on exhibition in Chicago. The public has displayed considerable curiosity as to the appearance of the little craft and its operation. With the view of giving the reader a correct idea of the construction of the air ship, the cut accompanying the description was reproduced directly from a photograph which was taken when the vessel was at its moorings in the exhibition hall. As to the merits of the invention the reader can best judge for himself.

PRESIDENT HARRISON last week issued the proclamation of reciprocity between Brazil and the United States. According to the reciprocal agreement machinery for all manufacturing and industrial purposes, except sewing machines, will be admitted to Brazil free of duty. It is predicted that the country will purchase no little machinery in the United States during the next few years. A great deal of money is being invested in Brazilian mines, and their development will involve a large outlay for electrical apparatus.

DIRECTOR-GENERAL DAVIS on February 5 appointed Prof. John P. Barrett of Chicago chief of the department of electricity of the World's Columbian Exposition. The announcement was received with general satisfaction, especially in the West, where Prof. Barrett is so well and so favorably known. Electrical workers for several months have been anxious that the department should be organized for the reason that they thoroughly realized that this section was to assume tremendous proportions. In World's Fair circles this fact has not been appreciated, at least until within a week or two. As soon as plans, even of a tentative character, were considered, the authorities were astounded at the immensity of the work which confronted them. They now realize that a commencement cannot be made too speedily. We are exceedingly glad, therefore, to note the appointment which is the first important step. Prof. Barrett is abundantly able to discharge the arduous and responsible duties of chief of the department. As the head of the municipal electrical service in Chicago his experience has been right in the line of his new position. He has demonstrated that he is possessed of marked executive ability which is the quality most needed in the organizer of the electrical department. Under his direction we expect to see the section thoroughly organized, and developed into a marvelous exposition of modern electrical work. The chief of the electrical department and the World's Fair committee of the Chicago Electric club will work together in harmony, and the electrical fraternity will co-operate with them in achieving grand results.

IT is understood that the general electrical building of the World's Fair, to be constructed at Jackson Park, will be a structure 675 feet long and 350 feet wide. With these dimensions the available floor space including that in the galleries will not be over six and one-half acres. This is a totally inadequate provision for the electrical exhibits. True, it is proposed to construct a comparatively small building on the Lake Front to accommodate electrical exhibits, but the total provision is by no means satisfactory. The latter building may not be constructed. There are obvious objections to dividing the electrical department. If, for no other reasons, this section should be located at one place because it will be a striking exhibition of an immense industry which has been built up within a few years; in other words to express the idea in the ordinary phrase, electricians want the section to "make a big showing." Those who want to study the entire exhibition of apparatus certainly do not desire a division of the section. There is in fact, every argument in favor of locating all the electrical apparatus at one point, and no valid argument that we have heard for a different arrangement. The location should undoubtedly be at Jackson Park, and a much larger space should be provided than is now planned for the electrical building.

The Chicago Electric club expressed itself on this point at its last meeting, and its resolutions doubtless voice the opinions of the fraternity generally. The structure at Jackson Park, as we have stated, is to be 675 feet long and 350 feet wide, according to the present design. This is a lamentably small provision. The building occupied by the electrical exposition in Paris in 1881 was 810 feet long and 354 feet wide, and the space, although considerably greater than that provided at Jackson Park, was entirely occupied. Electrical industries were in their infancy, indeed, in 1881. There is tenfold more apparatus to be exhibited from the United States alone to-day, than was available in the world in 1881. The general electrical building should be at least 1,200 feet long and 500 feet in width, and even then the dimensions will be found too small, we think, when applications for space begin to pour in. We trust that the authorities of the fair will realize these facts and either erect a much larger building than is now contemplated to begin with, or design a structure to which additions may readily be built.

THE World's Fair committee of the Chicago Electric club has been in consultation with the authorities of the exposition, within the last week, and its recommendations in regard to the electrical section are contained in a report published elsewhere in this issue. The document is one which will repay a careful perusal as, without a doubt, it will form the basis for all subsequent plans for the electrical department. In reading the report one is struck by its eminently practical character. The committee was asked for figures and general suggestions and it presents them in such a way that any practical man can thoroughly comprehend just what is recommended. The report gives something of an idea of the probable magnitude of the electrical department. As a preliminary suggestion the committee recommends that all the conductors be located underground. It is safe to predict that this suggestion will not be altered by Prof. Barrett, the chief of the department of electricity, who will not in all probability follow the report in every particular. To light the main part of the grounds at Jackson Park, the committee finds that 1,400 arc lamps will be necessary, provided that the tower system is adopted, which the committee thinks could be followed to great advantage. The committee estimates that 3,800 arc lamps and 50,000 incandescent lights will be required for illuminating the interiors of the buildings at the park. According to the committee's estimate a steam plant capable of generating 10,200-horse power would be necessary simply for the illumination of the grounds and main buildings at Jackson Park. In this estimate no provision is made for furnishing light to the state buildings or power to the numberless stationary motors which will be used in the several departments. A vast amonnt of machinery will be shown in operation in the several buildings, and the committee recommends that electric motors be used to supply them with power. In making this suggestion the committee explains in a very admirable way the advantages connected with employing motors instead of any other system of distributing power. If the plans of the committee are adopted even in their general outlines the generating plant will be a mammoth installation, and electricity will play a most important part in the economy of the fair. Of course the report is subject to revision and alteration, but the work of the committee has been so well done that in all probability it will be followed in its main features.

Indicating the Discharge of an Accumulator.[1]

It is extremely desirable in the use of accumulators that a device shall be available for indicating the extent of the discharge at a given time. Many means for indicating the state of a cell have been proposed and tried, but they have been discarded one after the other. An attempt has been made to obtain the desired result by using a differential meter to denote the variation between the current used in charging and that consumed in the discharge. This method besides being complex, gives incorrect results, for storage batteries are variable, and it is difficult, not to say impossible, to take

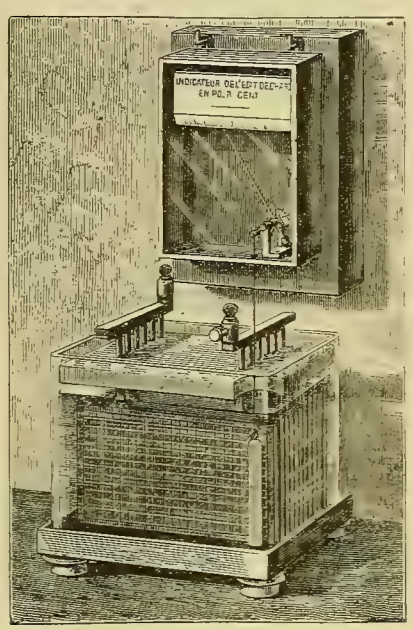

FIG. 1. INDICATING THE DISCHARGE OF AN ACCUMULATOR.

account of this factor in any differential meter. The attempt to accomplish the result by noting the variation in the weights of plates, which were attached to a delicate balance, did not meet with greater success.

During charging the sulphuric acid leaves the plates, and is added to the solution, which becomes more dense. The contrary effect is produced during the discharging period. Inventors availed themselves of this simple fact to devise apparatus for indicating the extent of the discharge. Results obtained in this way were inaccurate. Mr. Sellon then proposed in 1883 the employment of a hydrometer. This device was found objectionable, for the reason that it is hard to obtain a reading when the containing vessel is opaque. A still greater objection is found in the fact that the electrolytic liquid is not uniform; it is found that the

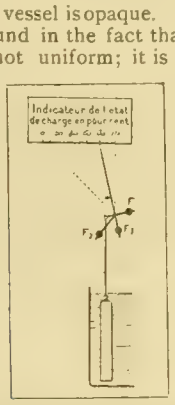

FIG. 2. INDICATING THE DISCHARGE OF AN ACCUMULATOR.

liquid grows denser and denser in proportion to the distance from the top.

To overcome these faults, which result in inaccuracies, G. Roux designed the device illustrated in the cuts. The apparatus is constructed on the principle that, within certain limits, the mean density of the electrolytic liquid varies proportionately to the quantity of electricity stored, so to speak, in the cell. The errors due to the changes in temperature during the phases of charging and discharging are so small that they may be disregarded.

[1] Abstract of an article in "La Nature."

The inventor has designed an instrument to indicate the mean density in spite of the fact that the liquid is not uniform. He employs a flattened tube of glass, the height of which is practically the same as that of the liquid. The hydrostatic thrust then acting upon the tube is equal to the product of the mean specific gravity of the liquid multiplied by the size of the tube; but the latter factor is constant, therefore it is simply necessary to take account of the mean density.

Fig. 1 shows the device as applied to an accumulator. Fig. 2 illustrates the principle on which it acts. The glass tube is so ballasted that its weight more than counteracts the effect of the upward thrust at the time when the cell is discharged. The tube is attached by a platinum wire to a small lever arm, which is horizontal when the cell is fully charged. Upon the same axis as the lever is a small rod upon which can be adjusted a little brass weight F_2. Perpendicular to the lever is a needle, which is balanced by the weight F_3, and which moves over a scale marked into 100 divisions.

When the accumulator is discharged the needle is set at the zero point on the scale. This is effected by adjusting the weight F_1. When the cell is fully charged the needle is set to the 100 mark by adjusting the weight F_2.

When these two adjustments are made the readings on the scale indicate directly in per cent. the amount of current remaining in the cell. The correctness is not dependent upon the absolute density of cell after the two points on the scale have been determined.

Tubes of varying length are used in accordance with the size of the accumulators. One indicator may be used for a battery of cells, but the inventor prefers to use two at points as far distant as possible in the series. By locating two contacts on the scale connected with bells, alarms can be sounded when the cells are becoming almost charged or discharged.

Tests of the apparatus when compared with the readings on an ammeter have shown that its utmost variation from complete accuracy is not over 3 per cent.; such a variation will not lessen the commercial value of the device.

Proposed Canadian Electric Light Association.

The best evidence of the popularity of electric lighting in Canada, and the growth of the business in that section lies in the fact, that the Canadian manufacturers and central station men are endeavoring to form an organization similar to the National Electric Light association in this country. A Canadian exchange says:

"Electric light men, as a rule, are busy men, with scarcely leisure enough to keep track of the many improvements and developments being constantly made in their art The meetings of the American association being held anywhere from Maine to New Orleans, or San Francisco, are altogether too inaccessible to the modest and busy Canadian. The adoption, also, by our friends of the screaming eagle, of a higher and thicker wall of demarcation between the two countries, would seem to make it desirable that we should depend upon ourselves in a greater measure than formerly, and should seek as much as possible a community of interests that would render an entire commercial separation or suspension of intercourse a matter of less injury to electric lighting interests. We are still dependent upon our neighbors to a certain extent, and it behooves us to look ahead a little and determine what can be done to best forward the interests of our industry. We are in receipt of communications from central station owners strongly advocating the formation of an association for purposes of mutual benefit, and shall be glad to hear further from any others on this point. It has been suggested that Toronto, being a central location, might be made the place of meeting for the inception of such an institution. Some time about or during the coming Industrial Exhibition might be mentioned as a suitable time. There is some talk of building a new Machinery Hall by the association, in which, no doubt, there would be ample facilities and space for a first class exhibition of electrical apparatus. Electricity has made rapid strides during the last year or two, and if it were made generally known that during the time mentioned electricians and electric light men would meet in conclave, special efforts would be made to centralize and exhibit all that is newest and best in electrical methods and appliances. The exhibition authorities would no doubt earnestly co-operate to make this branch of the Industrial a complete success An association of this kind should consist of those engaged in the business of manufacturing and selling electricity from central stations."

Electrical Section of the World's Columbian Exposition.

The electrical department of the World's Columbian Exposition will be one of the most extensive of the fair. Few persons, it is thought, have realized the enormous proportions which the section will assume. Certainly the World's Fair authorities have not done so until the present time at least. Even the electrical fraternity, although realizing the enormous development of the industry during the last ten years, have scarcely appreciated what would be an adequate exhibition to show the present state of the art. Something of an idea of the probable magnitude of the development can be gained by a perusal of the subjoined report of the World's Fair committee of the Chicago Electric club. The committee, as stated in the last number of the WESTERN ELECTRICIAN, met A. Gottlieb, consulting engineer of the exposition, and at his suggestion drew up the report embodying the ideas of the members. It is of course understood that the plans as formed by the committee may not be adopted. At the hands of Prof. Barrett, the chief of the department of electricity, they may be subjected to very material changes, but the report is extremely suggestive as indicating the probable magnitude of the department. The report will without a doubt form the basis on which the head of the section will form his plans. In all probability the figures representing the amount of power to be used, and the total number of lights to be employed, will not be modified to any great extent. Following is the full text of the report:

The committee on World's Fair matters, appointed by the Chicago Electric club, at your request, begs to report that as a result of meetings held on February 4 and 6, it has arrived at the following conclusions:

GENERAL ARRANGEMENT OF WIRES.

We recommend that the distribution of electric current, for arc and incandescent lighting, for electric railway and power purposes, be through underground conductors exclusively, with the exception of overhead arc light wires for outside illumination, and the railway trolley wires.

It is found on examination of the map that a conduit system connecting the several buildings can be very readily and inexpensively put down, for the reason that the space under the floors of the buildings can be used as part of the conduit. Conduit tubes of 2½ inches in diameter can be had in most inexpensive form for 5 cents per running foot, to which is to be added the cost of making and filling the trench. As the trench would be through soft earth, and very little if any paving or roadway would have to be disturbed, it would not cost a very large sum, and would be very much better in every way than any system of pole lines that could be devised.

AREA TO BE LIGHTED.

From the plans submitted, we find that the areas to be lighted are as follows:

A.	Agriculture, 825x500	412,500 sq. ft.
B.	Horticulture, 1,250x250	312,500 "
D.	Fisheries, 600x200	120,000 "
E.	Mines, 675x350	236,250 "
F.	Machinery, 1,000x500	500 000 "
	" Annex, 975x300	292,500 "
G.	Transportation, 1,200x250	300,000 "
	" Annex, 1,125x450	506,250 "
I.	Electricity, 675x350	236,250 "
H.	L. M. Manufacturers, 1,700x800, subtract for courts 2x475x400	1,360,000 "
	Government, 450x350	157,500 "
	Woman's Exhibit, 500x200	100,000 "
	Administration	126,000 "
	Depot, 500x250	125,000 "
	Show Ring, 400x250	100,000 "
	Total	4,884,750 sq ft.

TOTAL AREA TO BE LIGHTED.

The total area without Midway Plaisance is	29,200,000 sq. ft.
Midway Plaisance equals	3,710,000 "
Total	32,910,000 sq. ft.
Subtracting from this area the area occupied by the buildings, viz	4,884,750 "
Leaves a total outside area	28,025,240 sq. ft.
Or in round figures outside area to be lighted	28,000,000 "

LOCATION OF POWER STATIONS.

On the plan submitted to the committee, the station at which the power will be generated and where the dynamos will be placed, is in the extreme south end of Jackson Park.

The best and cheapest electrical arrangement would be to place the generating station in about the center of the territory to be lighted.

If it is not practicable to put the generating station in about the center of the lighting territory, a proportion of the lighting could be done from the station as at present

located, and another portion from the proposed station about opposite the Midway Plaisance on the Lake Shore.

As the plans submitted do not include any lighting for the State buildings, which are to be placed north of the line of the Midway Plaisance, this station could be called upon to furnish also whatever light and power would be needed for those buildings.

The best plan electrically would be to locate one station in the center of distribution.

Next best, two stations, one south and the other north.

Next, last and least desirable, station at south end, as now designated on map.

The difference in the advantages of these plans is mainly in the saving of copper wire, and consequent economy of electrical energy, as well as of the first cost.

LIGHTING GROUNDS.

We find from tables given in handbooks and other statistics, the following:

	Area to be lighted by 1 nominal 2,000-c. p. arc lamp.
Yards	20,000 square feet
Railway stations	15,000 " "
Foundries and rolling mills, general illumination	5,000 " "
Foundries and rolling mills, special illumination	2,500 " "
Dyeing establishments	2,000 " "
Printing establishments	1,500 " "

Supposing the lamps for outside illumination to be placed on poles, and allowing 15,000 square feet per 2,000-candle power arc lamp, we require 1,866 arc lamps, or 1,866 horse power at the power station. Such a distribution would place the lamps 122 feet apart.

As the proper height of the electric arc for lighting of large areas is .7 of the radius of the area to be lighted by one lamp, the arcs should be at a height of

$$\frac{.7 \times 122}{2} = 42.7$$

or practically 40 feet above ground.

Should it be decided to light the grounds by a system of towers, about 75 feet high, each tower to be equipped with, say 8 arc lamps, and the towers to be placed approximately 400 feet apart, it could be accomplished with about 1,400 arc lamps.

This will provide a flexible method of lighting, and make it possible to increase or decrease the number of lights on a certain tower as the circumstances may warrant.

It is thought that by this system all thoroughfares and paths throughout the park can be well lighted, notwithstanding the foliage.

By means of the tower system it will be practicable to connect one tower to the other with a single conductor for carrying the current. This single conductor will be, approximately, 75 feet above ground, and at that height there can be no possible danger, so that bare wire can be used and insulating material can be dispensed with.

This arrangement is by far the most economical, and at the same time efficient that can be suggested. No aesthetic objections can be raised to wires 75 feet above ground, as at that height single wires will hardly be visible.

The cost of one hundred and seventy-five towers, wired and ready to be connected with the electrical apparatus, will be, approximately, $100,000.

While the committee is fully aware of the fact that the tower system of general illumination in cities is not the popular form, and is only used in perhaps half a dozen cities in the United States, the advantages of this system under the conditions that will obtain at Jackson Park, where there are but few buildings to obstruct the light, will be very marked. Depreciation of bare wire is very little and after the close of the exposition may be sold for at least 80 per cent of its first cost.

LIGHTING BUILDINGS.

Although the total floor space of the buildings is only 4,884,750 square feet we think that about 30 per cent. more should be allowed for galleries, upper stories, etc. This will practically give us an area to be lighted inside of buildings of 6,000,000 square feet. If we assume one arc lamp for each 1,600 square feet, which practically puts the lamps 40 feet apart, about 3,800 arc lamps or horse power would be required, to give a general inside illumination. The proper height for these lamps would be

$$\frac{40 \times .7}{2} = 14.$$

For practical reasons, however, and other considerations, the height of the arc above ground should be increased to, say about 18 or 20 feet.

We estimate for the distribution of the arc current for 3,800 arc lamps in the various buildings, the conduit and underground wire to be laid from building to building will cost about $40 000.

This plan would require a provision in each building for carrying the main arc circuits through the buildings, and the wire used for this purpose would cost about $12,000 more.

The cost of wiring the lamps, ready for service, would be about $20,000, making the total for arc light distribution inside of the buildings $72,000.

While the arc lights will give a good general illumination inside of the buildings, the different exhibitions will need a large number of incandescent lights to effectively show each object under favorable conditions.

Assuming for each 120 square feet one 16 candle power incandescent lamp, we get a total of 50,000 16-candle power incandescent lamps, or 5,000 horse power.

We estimate that the cost of distribution for the 50,000 incandescent lamps, from the generators to the sockets, will be, approximately, $250,000. This would provide for laying the conductors underground between buildings, and using the buildings themselves as far as practicable for conveying the main circuit.

RECAPITULATION.

For outside arc lighting by towers	1,400	horse power
For inside arc lighting	3,800	" "
For incandescent lighting	5,000	" "
Total	10,200	horse power

Which we consider as a reasonable estimate.

NOTES.

1st. The term horse power refers to mechanical horse power delivered at the pulleys of the electric generators.

2d. For a plant consisting of a steam engine (compound condensing) to deliver 1,000 horse power, and electric generators of 1,000 horse power capacity, an area of 5,000 square feet is required.

LAKE FRONT.

As to the lighting of the Lake Front we believe that 200 arc lamps would furnish sufficient illumination for the grounds. The lighting of the buildings might be estimated on the same basis as has been calculated for the buildings at Jackson Park. In the art building, however, the number of incandescent lamps would probably have to be doubled for an equal area of floor space. Not having the dimensions of the buildings we can not state just how many horse power would be required on the Lake Front.

POWER.

The committee suggest that in all the buildings a certain amount of power will be required for the purpose of operating fans, sewing machines knitting machines, dental apparatus, elevators, pumps, and the thousand and one other appliances that need not be named, and that no better, more efficient or cleanly method of distributing this power can be found than by the use of the stationary motor.

The stationary motor can be used for any purpose where it is necessary to turn a wheel, and the amount of power to be delivered at a certain place can be anything from 1-16 of a horse power to 100 horse power, or more.

As the stationary motor is noiseless, clean, odorless and requires no special attention, and as the system is so extraordinarily flexible that motors can be placed on the floor, the wall, or on the ceiling, and take up but a minimum of room, its many advantages are self evident, and need no special commendation.

There is no waste of energy, the motors being self regulating, and adjusting themselves to the demands made upon them. The loss in energy, if steam were used for the purpose of furnishing power to operate the exhibits, on account of condensation and the loss by friction in turning long lines of shafting, will be enormous.

As a matter of fact, if the stationary motor is adopted for this purpose, there need be no shafting or countershafting at all, at a great saving in room and power.

Your committee is unable to give any figures as to the number of horse power in stationary motors that will be called for nor the cost, for the reason that it has no data upon which to base an estimate.

It can guarantee, however, that this method of distributing power will cost at least 50 per cent. less than any other system.

THE PROPOSED RAILWAY.

As the road is now proposed and shown on the map furnished, it contemplates 2 54-100 miles of single track and 1 35-100 miles double track, making a total mileage of 3 14-100 miles single track.

As the plan shows we cannot see any particular advantage gained by the double track and loop, which leaves the Administration Building, passing around Machinery F Building, and through the Annex around to the show ring. It seems that it would in fact be more desirable to avoid that loop and run out to the pier, where great traffic will undoubtedly have to be taken care of by reason of transportation via the lake to and from the fair grounds. It is very desirable also to avoid, if possible, the compound curve which is laid out to pass through the depot. If the line can be carried straight from the Transportation Building directly around the Administration Building, and thence east to the pier it would be cheaper to construct, and also permit of more rapid transit, for the compound curve would reduce the speed to a very undesirable point. On the return circuit we think it would be best to pass around to the west of the Government and Fishery Buildings, and avoid the expense of extra bridging as now proposed on the plan laid out on the map. However, if it is desired to give transportation facilities to the improved portion of Jackson Park it would be well to consider running the railroad between the Fishery and Government Buildings out north to the present pier, that is, north through a portion of the improved part of Jackson Park, and returning to Fifty-ninth street. The line as laid out on the map does not provide for a starting station, but contemplates a complete loop on which cars would have to travel continuously. If the road were to be operated electrically, it would be desirable to have a stopping and starting point, to avoid passengers taking advantage of a continuous circle, riding around and around the ground on one fare.

There seems to be two desirable points for the road to end, either at Fifty-ninth street or the Administration Building. The railroad, as now sketched out on the map with blue pencil, can be constructed entirely of single track, which now measures 2 57-100 miles to make a complete circuit of this line, having an easy schedule of 10 to 12 miles per hour requiring 12½ to 15 minutes to make this circuit, including all stops. The time being so short, it is not necessary to construct a double track if the single track will take care of the travel.

It is presumed that the road will be free from heavy grades, there being none to exceed probably 1 to 2 per cent. On such a line a single motor car, equipped with two 15 horse power motors could draw two trail cars, seating 45 passengers each, which would be of the open style; the motor car should be of the closed type, and capable of seating 35 passengers, making the total of 125 passengers seated to be hauled by each motor.

It may be desirable in locating the railroad to run out by the various boiler houses where the steam is generated for the various appliances, and have the coal hauled by the railroad at night, dumped into a chute which leads to the various boiler rooms. This, of course, would not interfere with the passenger travel in the least.

It might be also necessary to have a side track or spur at one or two places on the line for side-tracking any disabled cars to avoid delays and make good time. It would also be necessary to have ample ground space allotted for a suitable carhouse for storing at least 30 motors and 60 trail cars.

By having 15 motor cars in service, making from 10 to 12 miles per hour, including stops, one motor train could leave a given point every minute, capable of seating 125 passengers. The power per train, as described, will require on an average of 15 horse power, or 225 horse power for operating the cars; to this we should add 25 per cent. for emergency, or 56 horse power, giving a total of 281 horse power required delivered at the motors.

To have a motor train leave every half minute 562 horse power would be required, including 25 per cent. for emergency.

On the one minute schedule, basing our calculations on the seating capacity of the cars only, 7,500 passengers can be moved. On half minute headway, with 30 motor cars and 60 trailers, 15,000 passengers can be moved per hour. As it would be quite impossible to run on half minute or one minute headway, the solution is electric locomotives and long trains with at least two minute headway. This is based on through passengers and by reason of short riders at least one-fifth more than the number above stated, could be cared for.

If it is desired to run the motor cars the entire length of Midway Plaisance, a distance of one mile of double track or two miles of single track will be required and five cars on two minute headway, or 10 cars for one minute headway, or for each mile of extra single track, you will require 100 horse power for operating cars on one minute schedule. In furnishing the steam plant for the above work it would be better to add 20 per cent. to the above figures, giving a total of about 700 horse power required to do the work herein stated.

It seems to us that there are many objections to an elevated railroad in the fair grounds proper. First, the great cost, which would be in the neighborhood of half a million dollars for a road as now contemplated, the inconvenience of reaching the elevated railroad by steps, discouraging short riders, and the possibility of passengers expectorating from the windows, and throwing refuse from the cars on people's heads below, and dripping of oil from the journals and the possible danger from such an overcrowded road, while an elevated railroad at its best is certainly not ornamental.

If a surface railroad would be considered it should be double tracked, run to the rear of buildings, if there is any rear to them; (for instance to the south of Machinery F Building and Agricultural A Building), and viaducts should be built in places where it is necessary to have access across the grounds. It seems to us that 10 viaducts of an ornamental character could be constructed at a very low figure to answer all purposes, and give you the benefit of surface travel.

In constructing a surface railroad through the grounds of the World's Fair the same can be made unique and ornamental in many respects. The rails could be raised from the ties by means of chains to give a space of 8 inches, which would be covered with a rich mold, suitable for the planting of flowers and grass, and can be so arranged that the rails cannot be seen except by standing immediately over the center of the rails. There should be space allowed between the tracks, if it is constructed with double tracks to allow the erection of ornamental center poles, either of iron or octagon wood with ornamental brackets, from which the wire could be suspended for conveying the current to the trolleys of the motor cars. If desired, these poles could have various kinds of vines running around them which would make them exceedingly ornamental and pleasant to the eye.

Wherever a viaduct is located the stations should also be located for passengers for getting off and on, which would permit of passengers going from one side of the track to the other via the viaduct. For some 300 feet at the stations there should be a partition between the two tracks to prevent passengers from crossing the tracks instead of going around by the viaducts. It would also be necessary of course to have the railroad inclosed from one end to the other with a neat and ornamental fence.

We believe a surface railroad erected on such a plan as the above would be very attractive and something that has never been seen in this country or any other.

RECAPITULATION.

Horse power required delivered at generator pulleys:

	H. P
For lighting Exposition at Jackson Park	10,200
Electric Railway " " "	700
For power transmission to different buildings, and drive all sorts of machinery at Jackson Park... (Rough estimate)	9,000
Grand total	19,900

RECAPITULATION.

Cost for distributing the electric current for lighting, exclusive of apparatus, at Jackson Park:

Towers and overhead wire for outside arc lighting	$100,000
Conduits and wires for inside arc lighting	72,000
Conduits and wires for inside incandescent lighting	250,000
	$422,000

N. B.—No estimates can be given on wiring for electric railways or power transmission, until these matters have been put in a more definite shape.

Canadian Invitation to the National Electric Light Association.

At the last meeting of the National Electric Light association Albert J. Corriveau, of the Canadian Electrical Construction, Manufacturing & Supply company, Montreal, spoke to a number of members in regard to holding a meeting of the organization in Canada. He is still enthusiastic on this subject. In a letter which he has written to the WESTERN ELECTRICIAN Mr. Corriveau states some of the advantages which, he believes, would accrue to the association if it decided to meet in Montreal. In the first place he thinks an electrical convention would greatly stimulate the use of electrical apparatus in Canada, and the fraternity in general would thereby be benefited. He further states that a trip to Montreal would be exceedingly enjoyable, and that the members of the association would be royally entertained. He suggests the possibility of an official reception. He therefore, urges the association to hold its next summer convention in Montreal.

Electric Light in Mines.

An official of the Aurora Iron Mining company, Michigan, has made some very interesting statements concerning the comparative cost of lighting that company's mine by means of candles and electricity. He says that the cost for candles and oil for the year 1889 was $5,000, while the cost for incandescent lights during the year 1890 amounts to $7,000.

The lighting of the mine by means of electricity involves continuous illumination of shafts, drifts, rooms, etc., in fact of every part of the mine with such brilliancy that the miners can see wherever they go. They can pick up their tools at any place and need not grope in the dark trying to find a tool by feeble rays of a smoky oil lamp or candle, which lights an area of a few square feet only. The electric light lessens the liability to accidents that would endanger human life and destroy property. A few days ago a miner in a Michigan mine was struck by a tram-car and his leg was crushed. The accident would not have occurred had the workman been able to see the approaching car. In the Aurora mine such an accident would be extremely unlikely to occur. Miners are apt to be very careless in handling candles or oil lamps. They spike the candle stick in the timber and often let the candles burn down and set fire to the mine. Owing to steam pipes and hot air in most mines timbers get dry and inflammable. If a mine has been on fire the drowning loosens the timbers and even after the water is pumped out makes the access very dangerous.

Steam pipes are very undesirable in mines, and the electric motor is taking the place of steam engines rapidly. The speed with which miners can work by the electric light is almost double that attained when oil lamps or candles are employed. This was shown in Chicago a few years ago, when the water supply tunnel near 67th street was built under the lake. The employment of incandescent lights more than doubled the speed of progress in the tunnel which was first lighted by oil and candles. The use of candles fills the air with smoke and increases the difficulty of ventilating mines. An electric lighting system is practically under the supervision of the engineer or superintendent. The only objection that lighting by electricity was too expensive, is disposed of in the case cited where it is shown that the cost is only a little higher than for candles and oil, and the illumination many hundred times better. The installation in the Aurora mine was made by the Chicago office of the Thomson-Houston Electric Co.

Pumpelly Storage Battery Company, Chicago, Reorganized.

The Pumpelly Storage Battery company has been reorganized with a capital stock of $300,000, and the factory established in the Warren-Springer building, South Canal street, Chicago. Abner Crossman was re-elected president. The board of directors will be composed of Messrs. Crossman, Urigh, Simons, Mendelssohn, Heveridge and Pumpelly.

The company announces that with the excellent financial backing it has secured it will be prepared to go into the manufacture of batteries on a much larger scale than heretofore. Special attention will be given to street railway work. The company is much encouraged by the flattering notices it has received of the operations of the storage battery car in Middleborough, Ky. This car was equipped at Detroit with a Rae motor and Pumpelly batteries eight months ago. When it was shipped to Kentucky it was learned that the track on which it was expected to be operated was not adapted to the car, and the roadbed had to be reconstructed. The car was allowed to remain exposed to the weather until two weeks ago when the batteries were charged, and the car began its regular trips, giving thorough satisfaction.

The Edison General Electric company is installing a car and station equipment for the Oakland & Berkeley Rapid Transit company (narrow gauge). It also has contracts for furnishing two No. 32 railway generators for the Central street railway of Sacramento and one for San Jose, Cal. The latter is an increase. The plant at the Grover Mine, Amador, Cal., is nearly completed. This plant consists of one motor at the 400 foot level, and one at the 700 foot level. Both take current from the same generator.

CORRESPONDENCE.

New York Notes.

NEW YORK, Feb. 7.—Preliminary steps under the Rapid Transit act will be taken on Monday at the first meeting of the commissioners in their new quarters, in the Farmers' Loan and Trust company building, at William and Beaver streets. The meeting will be private, and no time will be lost in acting upon the important propositions which are now before the commission. An interesting plan was presented to the commissioners at their hearing last Thursday, by R. W. Gibson. His design is for a double track line just below the surface of Broadway to be operated by electricity. In addition to the railway line it is proposed to furnish space for pneumatic tubes, gas, water and steam mains, conduits for electric wires, and a cable subway.

Poor construction work in the wiring of the assembly chamber at Albany was the primary cause of a slight fire last week. It was discovered before it had made much progress, fortunately, and was extinguished.

James M. Slocum, the baseball player who murdered his wife Ellen on Jan. 1, 1889, in a tenement house in Roosevelt street, was taken before Judge Martine this week for resentence, the Court of Appeals having affirmed his conviction of murder in the first degree. Judge Martine sentenced Slocum to die by electricity in the week ending March 16, the same week as that in which Smiler has been sentenced to be executed. Slocum was taken back to the Tombs, and will be sent at once to Sing Sing. Another appeal is contemplated.

The opponents of electric lighting are constantly stirring up the subway muddle, their last movement being the circulation of a report that the wires would be buried at once. At the office of the United Electric Light & Power company, which claims to control over three-fourths of the street lighting, it was said that it would be impracticable to place wires underground. The company had no authority to open the streets, and the only way the matter could be accomplished was by the rental of privileges from the Consolidated Subway company, which owns the underground conduits. These charges were considered exorbitant and practically prohibitory. As a result of a dispute a case was pending in the court to determine the status of the United company with reference to the underground rights. An officer of the Consolidated Subway company said that he knew of no negotiations progressing for the use of their conduits by street lighting companies. On the other hand, work is going on actively to straighten out the tangles along Sixth, Seventh and Eighth avenues, and Fifty-ninth and the other cross streets.

At the annual meeting of the Postal Telegraph Cable company the following directors were re-elected: W. C. Van Horne, George S. Coe, Albert B. Chandler, C. R. Hosmer, James W. Ellsworth, W. H. Baker, Edward C. Platt, John O. Stevens and George G. Ward. The resignation of vice president and director Hector De Castro was received and accepted, and J. W. Mackay, Jr., was elected as a director in his place, and Edward C. Platt was appointed to fill Mr. De Castro's place on the executive committee.

The strike on the Edison building has been settled, the union workmen winning. All non-union men will be discharged. W. H. T.

Minneapolis, Minn.

MINNEAPOLIS, Minn., Feb. 4.—The past two weeks have been fraught with developments of great importance to the new electric railway interests of the State of Minnesota. State Senator McMillan's bill to regulate the payment of fares according to the accommodations furnished, is causing a good deal of trouble. This bill, which the author intends shall exempt the passenger not provided with a seat from the payment of fare, has been followed by the introduction of another reducing the fare from 5 to 3 cents during the hours when laboring men are going to and from their work. The former bill is now in the hands of the committee on corporations, and is being given a great deal of consideration. There is practically no public sentiment favorable to its passage, and its consideration has drawn forth some strong protests. The committee on corporations has held a conference with the street car companies of the state, at which that committee was furnished with some general explanations regarding the work of electrical construction which ought to be effective in stopping the contemplated legislation. At this meeting Thomas Lowry and Judge M. B. Koon represented the Minneapolis Street Railway company, and Superintendent Scott the St. Paul company, and W. G. Decelle, vice-president of the Winona Street Railway company, was present with a protest from his city. Senator McMillan stated that his sole object in introducing the bill was to obtain a better service from the companies, claiming that the service on the east side in Minneapolis was especially inadequate to the demands upon it. Mr. Lowry stated in reply that the transformation of the lines referred to would be finished the first thing in the spring, and the citizens of that division furnished with a service in all respects as good as that of the west side. Judge Koon, on behalf of the Twin City companies, for which he is attorney, went into the details of the matter, stating that if the companies were not crippled by hostile legislation they would have every line in each city completed within a year, and so finely equipped that there would be no possible opportunity for complaint. The sum of $4,000,000 has already been expended in the transformation of the horse car systems into electric lines; $2,000,000 in Minneapolis, and $2,000,000 in St. Paul. During the coming year $2,000,000 will be added to the investment, half in each city. As there was no popular demand for such legislation it could have no other motive than to cripple the companies in their great undertaking, and if it were to become a law it would be a serious blow to them. Judge Koon stated, and the statement was corroborated by Mr. Lowry, that the negotiation of the companies' bonds has not yet been finally completed, and that hostile legislation would undoubtedly complicate this matter to the serious loss of the companies. As indicating the improvement made in the Minneapolis service during the past year Mr. Lowry states that in 1888 155 horse cars were required to transport the public, while there are now 349 electric cars in actual operation. Similar improvements have been made in St. Paul. Responding to a question of Senator McMillan Mr Lowry stated that last year the St. Paul roads lost $66,000, and the year before $90,000. Last year the gross receipts were: St. Paul, $595,000; Minneapolis, $700,000. The losses at St. Paul were due entirely to the state of transition the roads have been in the past two years, and the management of the corporation justly deems any exactions like the one contemplated, uncalled for.

The Minneapolis Street Railway company will transfer cars across the new Hennepin avenue bridge the coming week, while the paving is being completed, after which it will be ready to finish the east side electric lines.

A new transfer system has been inaugurated on the Twin City lines, by which the passenger desiring a transfer buys a check for 5 cents, which is refunded when the check is presented. The old system of securing transfers from agents stationed at various points did not prove successful, and entailed a large loss upon the corporation.

The Gallagher bill regulating street car fares, now before the state legislature, is as follows:

SECTION 1. It shall be unlawful for any person or corporation connected with or operating any street railway or system of street railway in any city of 75,000 or more inhabitants, which street railway or system thereof is propelled or operated by electric or cable power, to charge, demand or receive to exceed 3 cents per passenger as fare for the carrying or transportation of any passenger over any continuous line of such street, railway or system thereof, between the hours of 5 and 8 A. M., and between the hours of 5:30 and 7 P. M; the hour to be determined by the time when the passenger enters the car of such railway or system; provided, that this section shall not apply to transportation of passengers on Sundays and public holidays.

The second section defines "any continuous line" to include the present system of transfers in vogue in the Twin Cities.

During the late snowstorm the electric lines in the Twin Cities were operated without delay, and in an excellent manner. The snow plows were propelled by summer motor cars, and kept all tracks in the city in good condition.

The interurban service is about to be improved by a new time card, under which cars will run late enough to enable people of either city to go to the theaters of the other, and return by this route. A few more of the large motors will also be put on. N. O. F.

Pittsburg, Pa.

PITTSBURG, Pa., Feb. 7.—John A. Brill, of the Brill Car company of Philadelphia, was in Pittsburg a few days ago. In speaking of the car industry of this country he stated that electric street railway work had been monopolizing nearly all the car factories of the country for more than twelve months.

Leonard Frankert, a seven year old boy, was killed by a cable car yesterday in front of his parents' home in this city.

The Board of Directors of the East End Electric Light company, held a meeting yesterday at their office in the East End for the purpose of organizing. This was done with the result that A. T. Rowand was elected president; James H. Willock, vice-president; G. P. Shane, treasurer and general manager; and E. G. Miller, secretary.

The Union Switch & Signal company of this city, one of the Westinghouse interests, has just obtained the contract for the largest interlocking railroad crossing in the

world. It will be located in Chicago, and will be used by the Pennsylvania, Chicago, Alton, Chicago and Western Indiana and the Chicago and the Madison and Northern roads. It will require sixty levers to operate the various attachments.

The recent mine disasters in the western part of this state have been the means of bringing out valuable suggestions as to how coal mines should be lighted. The latest scheme is electricity, and a movement is now on foot to have a bill presented before the state legislature compelling the lighting of all mines by incandescent lamps.

The annual meeting of the Suburban Electric Railway company was held yesterday, and a committee was appointed to secure bids for the building of a new power station. The Suburban Railway company, until six weeks ago, obtained its motive power from the St. Clair electric road. This road has been running for some time, but the venture proved to be unsuccessful, and the management had to decide to discontinue the operation of the road. This, of course, compelled the Suburban company to shut down its road also. For this reason the company has to build a power house of its own, and the bids have accordingly been advertised for.

A valuable horse fell down and died in this city a few days ago while crossing a street which is traversed by an electric road. Like most of the sensational newspapers in other cities, a few of the Pittsburg journals came cut the same day stating that the deadly current had once more obtained a victim. While describing the accident they said that the horse had stepped on the rail, and that the electricity contained in the rail had killed the animal. The horse was valued at $3,000, and his owner, who also believed that the horse had been killed by an electric shock, called in a veterinary surgeon, who held a post-mortem examination, resulting in the discovery that the horse had died of heart disease. Thus, fortunately, the electric current was vindicated. E. H. H.

Cleveland, O.

CLEVELAND, Feb. 7.—The Youngstown electric railway will be extended through Niles and Girard to Warren.

The people at Canton are clamorous for an electric railway between Canton and Massillon.

The Ford-Washburne Storage Battery company will be composed of Geo. A. Ford, Geo. A. Washburn, Geo. Hoyt, Lester A. Cobb and Wm. H. Marshall.

To test the respective merits of gas and electricity as street illuminants, the Cincinnati *Times-Star* advances the idea of lighting alternate squares with electricity and gas. It is said that the scheme will be tried.

The United Electric company of Brooklyn Village, a suburb of Cleveland, has been organized with Dr. G. B. Farnsworth, president, D. B. Fish, vice-president and treasurer, J. L Stadler and W. E. Irish, directors. The capital stock is $50,000. The company will locate a factory and manufacture the patented electrical contrivances of Mr. Irish.

Local and outside capital is interested in the advancement of a new West side electric street railway project. For some time past the Berea Street Railway company has talked of extending its line to Cleveland from Berea. It is now said the road will be run on Lorain street to the city limits.

The Merkhofer Electric company of Cincinnati has made an assignment, with assets and liabilities about equal.

A new corporation is the Twin City Electric Street Railway & Light & Power company, of Dennison and Ulrichsville, capital stock $25,000.

The board of public affairs of Columbus has advertised for bids for 800 arc lights. R.

Lousville, Ky.

LOUISVILLE, Ky., Feb. 4.—Electricity as a motive power on eight of the local street car lines instead of on one route, as at present, will be an assured fact now within two months. The converging point of seven of the lines will be at Fourth and Market streets. The Green street line has already been extended so that it is five miles in length. The other nineteen lines, one by one, will be electrically equipped as rapidly as possible. It was expected that the seven lines would be running ere this, as everything has been ready for weeks except the trolley wires, but the motors were delayed in shipment, as a result of the rush of orders at the factory.

Superintendent Minary of the Consolidated lines, said a few days ago: "We have been somewhat delayed on our buildings, but everything is getting along nicely now. The improvements at the Seventeenth and Walnut street power house have been completed and nearly all the generators are in. This station was originally built for a 240-horse power house, but is now 800. The power house at the east end of Jacob street is nearly ready. Work is progressing slowly at the third power house, Seventh and Hill streets, but the down-town house will supply all lines below Sixth Street till the latter is ready."

The most important feature will be a through-town line, beginning at the Blind asylum, beyond the eastern limits, and extending down to Thirty-fifth and Water. This is between eight and nine miles.

"A large car shed has been put up at Fourth and C streets for motors and trail cars and the cars at first will run only to Fourth and C, but by the time the spring meeting of the Jockey club begins the cars will be run to the race course. It will be seen that Louisville will not be behind the times."

Boston capitalists have taken hold of the proposed electric line to Jacob Park, six miles out, which the Consolidated lines did not consider favorably. The contract has been awarded, it is said, although the names of the Boston capitalists have not been given out. The trade was brought about by a number of real estate men owning property along the road to the park. The contract calls for the completion of the road by April 15. This is the only other line of any sort so far, independent of the Consolidated lines.

The Thomson Houston company has taken an elegant suite of rooms in the Commercial building for its branch office in this city.

At Maysville, Ky., the electric line was completed and the first car passed over the road last week.

A receiver has been appointed for D. R. Burns & Co. of Peru, Ind., manufacturers of electrical supplies. The liabilities are said to be $51,000 and assets $25,000. The firm has been in operation about six months.

The Bowling Green, Ky, Gas company will put in an electric light plant which will furnish the entire city with incandescent lights. J. W. L.

Kansas City, Mo.

KANSAS CITY, Mo., Feb. 3.—Macon City is illuminated by Excelsior arc lights. The plant is owned by the city.

At the stockholders' meeting of the Kansas City Electrical Works, W. H. Woodring, A. R Lyon, C. S. Gilbert John S. Vale and D. A. Williams were chosen directors. At the meeting of directors W. H. Woodring was re-elected president, John S. Vail of Illinois vice-president, A. R. Lyon of Kansas City secretary, and D. A. Williams treasurer. Mr. Woodring was appointed general manager, and C. S. Gilbert superintendent for the ensuing year.

The quarterly meeting of the directors of the Missouri & Kansas Telephone company was held at the general office here last week. A dividend of 1 per cent. was declared, and made payable February 10, making the total dividend 4 per cent., as against 4½ per cent. last year. The annual meeting of the stockholders followed. The company's representatives reported a slight increase in the gross amount of business for the first half of the year, with an increased demand for improvements. The superintendent asked for $250,000 for the plants at Kansas City and Atchison, and for improvements at St. Joseph, Springfield, Topeka, Wichita and Leavenworth. The recommendation was taken under advisement. Ths following were elected directors: S. A. Walker of St. Joseph, Mo.; George Albree, of Chicago, Ill.; C. E. Yost of Omaha, Neb.; J. S. Chick and W. B. Clarke of Kansas City, Mo.; S B. Sweet and J. R Mulvane of Topeka, Kan.; J. E. Hudson of Boston, Mass., and E. E. Cook of Davenport, Ia. The directors elected the following officers: J. R. Mulvane, president; W. W. Smith, secretary; N. R. Furgeson, treasurer. C. W. McDaniel was appointed superintendent of outside exchanges, H. W. Crabb assistant superintendent, and W. W. Smith, superintendent at Kansas City. The executive committee consists of J. R. Mulvane, George Albree and J. S. Chick.

It is expected that the request of Superintendent Smith for $250,000 for improvements will be acted upon at the meeting on the fourth Tuesday in February.

The committee on corporations, other than railroads nnd insurance, Senator Teasdale of Kansas City, chairman, will devote a half a day to the subway bill, introduced in the Missouri legislature by Senator Stone. The bill provides for putting all electric light, telegraph and telephone wires underground. When the bill was first introduced it included all electric wires, but it has been amended so as to exclude electric street railway wires. Delegations from St. Louis, Kansas City, St. Joseph and the smaller towns in the State where there are electric companies will send delegations to present arguments to the committee against the passage of the subway bill.

Representative Hawkins will introduce a telephone bill which in its provisions is very similar to that killed two years ago after a hard fight. The bill provides that no telephone company shall charge more than $50 per annum for any telephone in a business house or residence, and not more than $75 a year for any public telephone.

Two weeks ago at Augusta, Ga., the water was turned on the wheels at the Augusta street railway power house, and the electric motors were run with that power for the first time. The honor of turning the water on was given to Mrs. Dyer and Mrs. Jarvis of Kansas City. There were present S. M. Jarvis of Kansas City, of the Jarvis-Conklin company, who is one of the promotors of the system; Mrs. Jarvis, president, and Mrs. Dyer of Kansas City; H. T. Purdy, inspector of the Edison General company; Wm. Carroll, inspector of the Augusta road, and others. Mr. Jarvis says this is the cheapest water power to be found in the United States. P.

St. Paul, Minn.

ST. PAUL, Minn., Feb. 1.—St. Paul and Minneapolis are coming to the front as a great electrical center, containing enterprises of an electrical nature which require millions of capital. The enormous electric street railway system, the electric lighting systems, the large manufacturing establishments and supply houses, all of which are being extended, make the two cities of great importance in the electrical world.

A faint idea of the development of the electrical interests in this territory, within five years, to their present gigantic proportions, can be gained by considering a few figures obtained by your correspondent while investigating the subject recently. At the commencement of the period indicated a few men in charge of an occasional isolated lighting plant, a few workmen engaged in bell wiring, together with the telephone and telegraph employes, made up the list of those employed in electrical work. The number of men, women and boys did not exceed two hundred and fifty, all told. At the present time according to a conservative estimate in the different lines of work in the two cities not less than two thousand men, are employed, which means that there are sustained by electrical employment directly, fully five thousand persons. Upon the completion of the electrical railway system this number will be doubled.

Among the leading establishments in St. Paul, in any line, and undoubtedly the most extensive electrical house in the Northwestern states, is the Northwest Thomson-Houston company. This house handles Thomson-Houston apparatus in all the immense region north of the Union Pacific railway, extending through to the coast. Some idea of the extent of this territory can be gained from the statement that in area it is greater than fourteen states the size of Pennsylvania, and while its resources are yet largely undeveloped the possibilities are almost beyond comprehension The managers of this great establishment are nearly all young men; still by tireless energy and good judgment they have built up a business of immense proportions Some changes have recently been made that will strengthen the executive force of the company. J. B. Tarbox, who has been for some time the efficient treasurer of the corporation, has resigned to take charge of the supply department, while the treasuryship has been filled by the promotion of Geo. C. Duffey. Great activity prevails in the electric street railway department at present.

Among the more important enterprises of this character on hand, and now nearly completed, is the West Street & North End electric railway of Seattle, Wash. This road was so far completed that one motor was put into service on Nov. 17, and the remainder of the equipment is now well in hand. The road is five and seven-tenths miles in length, and is to be supplied with twelve cars each supplied with motors of the standard size. A new power station is also being erected which is to be equipped with three 80-horse power generators and two Hamilton-Corliss engines of 100-horse power each. Another road at Seattle owned by the Ranier Avenue Electric Railway company, seven and one-half miles in length, is also in course of construction, which with a line at Bellingham Bay, near Whatcom, constitute the company's uncompleted contracts on the Pacific coast.

Nearer home work has also been active and at present two roads are under way at Duluth with several excellent contracts in various directions signed for next season.

The lighting department is also busily engaged in putting in several large plants, the most important of which is one of 1,300 lights at Stevens Point, Wis., and one of 1,200 lights in the Metropolitan Opera House, St. Paul. In the sales department business is reported good, and while collections have been somewhat slow, better times are looked for. With the energy and vim that characterize this establishment the outcome cannot be otherwise than satisfactory.

Another representative house, and one that has the impress of success stamped upon it is the Columbia Electric company, located at 207 East Fourth street, with an

extensive factory and repair shop at Upton Grove. This house is destined to become famous through the many valuable inventions and improvements that it has given, and is about to give to the world. A new dynamo and motor, with an arc light which has just been illustrated in the WESTERN ELECTRICIAN, to be known as the "Columbia," constitutes only one of the many valuable lines of apparatus owned by this company. Three of the motors, one of 30-horse power and two of 10 each have just been built and placed upon an experimental snow plow and track sweeper combined, which this company has completed for the St. Paul & Minneapolis electric street railway line. The larger one is used to propel the car and the smaller ones to handle the brushes. It is predicted that this plow and sweeper will be a great success which, if found true, will cause the Villard officials to place orders for a number of them with the Columbia company. The electricians of the company are at work on several novelties which will soon be made public; an electrical type-setting machine, among the rest, which they are perfecting for other parties, is being watched with great interest. The Columbia has a store room well stocked with supplies, and with strong men behind the enterprise it would appear that success could not be questioned. The company takes the business and good will of the Acme Electric company and profiting by the experience of the old incorporators, and by the infusion of new blood it would seem to be an easy task to build up an extensive business in the immediate future.

The Electric Engineering & Supply company, 413 Jackson street, requires no descriptive article relating to its business, the name adopted being explanatory and complete. The company was organized on October 20, but in this short time a large amount of business has been secured with excellent prospects for next season. C. A. Daigh, the president and organizer, was for many years the efficient secretary and assistant general manager of the Northwest Thomson-Houston company, while Morgan Brooks, the secretary and treasurer, held for a long time the same position with the St. Paul Gas company. These gentlemen have secured the agency for the Westinghouse apparatus for the Northwest, and with commendable zeal and energy are taking a hand in all competitive business offered Among recent contracts secured is one at Whitewater, Wis., of 500 lights, an addition to a plant already established. This plant is now run with a Corliss engine, but the additional power is to be supplied by a Beck engine, the contract having been secured by J. M. Badger of St. Paul, the Northwestern agent for that company. Mr. Daigh has recently planned and executed the wiring of the new Masonic temple of St. Paul. It was desired that the forty-eight lights on the stage in the main audience or lodge room be so arranged that they could be controlled by switches at two different points, the idea being to give the operator in charge of the stereopticon immediate control of the lights so that the desired effects could be produced when that instrument was being used, and at other times allow the lights to be handled at the usual place at the right of the stage. This was accomplished, the wires starting from the initial switch in the wings and running to a point fixed for the location of the stereopticon, and thence in parallel to the lights. The company has a pleasant office and supply room and with the experience of the gentlemen interested and the facilities at hand, there can be no doubt as to the results.

Ames, Wright & Co., the representatives of the Western Electric company of Chicago, have a fine salesroom at 51 East Fourth street, but their rapidly increasing business has made it necessary for them to secure increased facilities, and to accommodate this imperative demand they have arranged for the entire first and second floors of an elegant new building directly opposite their present quarters which will be ready for them soon. They report an excellent business for the past season, with the best of prospects for the next year.

C. J. Thomson is another of the energetic representatives of the electrical interest in this territory. His main office and salesroom is located at 320 Robert street, with a branch in Minneapolis. Mr. Thomson is the Northwestern agent for the Continental Dynamo company and the Detroit Motor company, and reports numerous sales for the apparatus. Among recent contracts is one with the Leijengren Furniture company for a 10-horse power motor and one with the Steavens Paint company for one of 15 horse power capacity, both in Minneapolis. Mr. Thomson has also just installed a 250-light Continental plant for the Bohn Manufacturing company of St. Paul, which with some recent large wiring contracts, has made business more than usually active.

F. J. Renz, 327 Minnesota street, reports an active demand for the Perret motor. His recent contracts comprise one of 10-horse power capacity, to run the freight elevator for the C. W. Hackett Hardware company, Fourth and Wauconta streets, and one of 4-horse power capacity for the W. L. Banning Printing company. Mr. Renz is an active, capable business man and the interests of this popular apparatus in the Northwest are in good hands.

The D. & D. Motor company is distinctly a St. Paul enterprise, and one that has splendid prospects in sight. Just how the name came to be adopted or what it means is not clear, but the motor has many very desirable features and will undoubtedly have a large sale. The company has a repair shop and factory at 327 St. Peter street and is doing a large and satisfactory business.

As a whole the electrical business in St. Paul is in a very satisfactory condition, with the very best prospects for the beginning of the new year. HOLT.

THE ELECTRIC LIGHT.

The people of Del Rio, Tex., are anxious to have an electric light plant erected in their town.

The city electric light plant at Danville, Va., will be enlarged. An incandescent plant will be added.

An electric light plant will be installed in the works of the Old Dominion Iron & Nail company of Richmond, Va.

The city council of Lexington, Va., has appointed a committee on light to secure estimates on the erection of an electric light plant.

An electric light plant consisting of a Thomson-Houston 50-arc machine, and a 500 light incandescent dynamo, is being installed at Troy, Ala.

The Orangeburg, S. C., Electric Light & Power company will increase its capital stock to $36,000, and the plant will be improved and enlarged.

The Farmville, Va., Electric Heat & Power company, has awarded a contract for the erection of an electric light to the Thomson Houston Electric company of Boston, Mass.

A bill is under consideration in the Colorado legislature providing for the borrowing of money and issuing of bonds by cities for public works, including the establishment of electric light plants.

Bids for lighting San Diego, Cal., have been requested. They will be opened Feb. 19. Eleven masts with six 2,000-candle power arc lights each, and twenty-two single 2,000-candle power lights will be required.

The Brush Electric Light company of Cleveland, Ohio, the California Electric Light company and the San Jose Electric Light company have secured injunctions restraining the Electric Improvement company of San Jose, from infringing on the double arc lamp patent.

A company has been organized at Falls Church, Tex, with E. A. Breenough, president, and T. R. Gordon, secretary, for the purpose of erecting an electric light plant, contract for which has been let to the Edison General Electric company of New York. The cost of the plant will be $10,000.

The Morgantown, N. C., Development company will erect an electric light plant. A stock company has been organized at Henderson, N. C., with W. H. S. Burgwyn, president; J. R. Young, vice-president; and J. P. Taylor, secretary, to purchase the electric light plant of the Henderson Electric & Gas Light company, and will, it is reported, improve and operate it.

THE ELECTRIC MOTOR.

An electric street railway will be constructed at Owensboro, Ky, provided a franchise is granted.

The Metropolitan Railroad company, Washington, D. C, contemplates the erection of a power plant at an early day. It will operate its lines by electricity.

It is announced that the city of Rochester, N. Y., is considering the project of installing electric motors to operate lift bridges over the Erie canal which passes through that city.

The Boise City, Idaho, Rapid Transit company has awarded the Edison General Electric company the contract for two and a half miles of electric road and power plant in Boise.

A dispatch from Aurora, Ill., Feb. 1, says: The first electric car was run over the line of the new electric street railway company this afternoon. The trial trip was made over the Downer place route, and was a great success.

The Adams Electric Railway company, East St. Louis, has been formed to acquire and dispose of patents relating to electric railways, manufacture motors, machines, vehicles, cars, etc.; capital stock, $5,000,000, incorporators, Edward V. Ringo, Augustine E. McBee, and E. A. Engler.

The Seattle, Wash., Electric Railway & Power company has sold all its property to a new company named the Seattle Consolidated Street Railway company, which has just been formed. The new company has $1,500,000 capital stock, of which a large proportion is held by Eastern men, though Seattle men retain control. The company operates twenty-two and one-half miles of track, running from Pioneer Place to Lake Union, Fremont and North Seattle.

The Belt Electrical Railroad company, Los Angeles, has let partial contracts for twelve miles of double track. This part of the system is to be completed in July, at a cost of over $700,000. Two 500-horse power triple expansion condensing engines will be put in the power house. The Pacific Roller Mill of Los Angeles has the contract. The route covered by the present contract for construction is, beginning at the Arcade depot, on Fourth street to Spring, on Spring to Second, on Second to Olive, on Olive to First, on First to Bonnie Brae, on Bonnie Brae to Westlake park.

The Western Power & Mining department of the Thomson-Houston Electric company, which also represents the Thomson-Van Depoele Electric Mining company, reports the following sales: Springside Coal Mining company, Pana, Ill., one 30-horse power generator and one electric coal cutter; Hamilton Ore company, Iron Mountain, Mich., one 80-horse power generator, one 60-horse power motor and one electric mining pump with a capacity of 500 gallons per minute against 1,500 feet head; Edinburgh, Ill., Coal Mining company, one 30 horse power generator and four electric coal cutters; Sangamon Coal company, Springfield, Ill, one 30 horse power generator and one electric coal cutter; Southwestern Electric Light & Water Power company, Joplin, Mo., one 100-horse power generator, four 7½-horse power motors, six 10-horse power motors, three 15-horse power motors for long distance power transmission; Bessemer mine, Michigan, one 30-horse power generator, one 15 horse power hoist, one electric sinking pump, one electric percussion drill. The Western Power & Mining department of the Thomson-Houston Electric company was organized less than two months ago under the management of F. B. Badt. This department controls the sale of machinery for mining, electrolysis and long distance power transmission only. The stationary motor department, which is entirely distinct, controls the sale of electric motors for all other purposes. The success of the power and mining department is due largely to Prof. Badt's personal efforts. He has made the subjects which come under this department a special study and he expresses the belief that this will become one of the most important applications of electricity to industrial progress.

THE TELEGRAPH.

The Vibro Telegraph company of Chicago has been incorporated to manufacture telegraph instruments, build and operate telegraph lines; capital stock, $100,000; incorporators, William E. Sloan, John E. Hughes and Orrin S. Reed.

The traveling public will welcome legislation similar to that enacted by the Georgia legislature at its last session providing that no person under the age of eighteen years shall act as a telegraph operator on any business or railroad line, and that every operator, before entering the service of any railroad, shall pass an examination as to competency. Tennessee operators will push a similar measure before the legislature of that state. They claim that the passage of these bills means the disappearance of the boy operator and a corresponding decrease in the number of accidents resulting from the employing of inefficient, immature and inexperienced railroad telegraphers.

Miscellaneous Notes.

The Sunset Telephone and Telegraph company is preparing to extend its system from Sacramento to Auburn and beyond.

Henry Schearer, city electrician of Peoria, Ill., is accused of robbing the safe of Bowe & O'Brien in that city. He is charged with stealing several hundred dollars.

The Day Electrical Construction company of Chicago has been incorporated to manufacture electrical motors, dynamos, etc.; capital stock, $1,000,000; incorporators, Edwin F. Getchell, Leroy D. Thompson and Norman L. Ross.

The Carpenter Electric company has been incorporated at Chicago; capital stock, $10,000,000; for the manufacture of electrical machinery, storage batteries, motors, dynamos, and electrical implements and appliances; incorporators, Hiram H. Carpenter, Herbert F. Kent, and Samuel D. King.

The exhibits at this year's electrical exhibition at Frankfort-on-the-Main will be divided into eleven sections. In the sections devoted to railway appliances the Prussian and Bavarian State Railway Departments will both send exhibits of signaling and lighting apparatus. In this section will also be found four electric railways, illustrating the overhead and underground conductor systems, and also accumulator working. In the telephone and telegraph sections, the German government will show a historical collection of apparatus. The Bavarian, and probably the English governments, as well as a large number of private firms, will send examples of the latest forms of apparatus. Siemens & Halske's exchange instrument, which works a number of typewriters from a central station, will be shown and also Mix & Genest's telephone automaton. Special rooms will be provided containing telephones connected with concert halls in Frankfort, Wiesbaden and Munich. The electro-chemical section will contain exhibits from fourteen firms. Among other processes one for obtaining pure copper from its ores will be shown. The Aluminum company of Neuhausen will have a good show of specimens of aluminum and its alloys. Among the exhibits in the medical section will be the arrangement adopted by Hertz in his researches on the nature of electricity, and numerous specimens of laboratory apparatus, sent both by scientific institutions and by private firms. Twenty-two firms are sending dynamos. Some 600-horse power dynamos, the largest hitherto built in Germany, are to be included. A large number of alternators will be shown and methods of transmitting power by the alternating current will be illustrated.

About 500-horse power are to be transmitted to the exhibition by electricity. Of this total 100-horse power are to be brought from the Palmengarten, 100 horse power from Offenbach, and 300-horse power from Lauffen-on-Neckar, 100 miles away. At a conference recently held at Munich, between the Allgemeine Elektricitaets Gesellschaft, the Maschinenfabrik Oerlikon and the Lauffen Cement Works satisfactory arrangements were concluded with regard to the division of the cost of this transmission. The carrying out of the scheme only depends now upon the action of the German postal authorities, who have been asked by the joint committee of the three firms to lend the necessary telegraph posts and fittings. There will be also six batteries of accumulators capable of furnishing 400-horse power. In the distribution room a large collection of apparatus will be in use. Siemens Brothers are laying down a cable to carry a current at a pressure of 20,000 volts. In this room the current will be supplied to the lighting and power mains. Electric motors will drive five pumps, taking in all 250-horse power, to supply water from the river Main to the exhibition. Power from the same source will also be used to work a fire engine, a glow lamp factory, a mill, and mining machinery. In the installation apparatus room 75 firms are represented.

Personal Mention.

Dr. George L Austin of the *Electric Railway Advertiser*, Boston, was in Chicago last week.

Col. W. A. Sheldon, of the Schuyler Electric company, was in Chicago the first of the week.

Messrs. Shurtz & Cannon of Portland, Oregon, are among the late Western visitors to Chicago.

H. H. Walter, general manager of the Card Electric Motor & Dynamo company of Cincinnati, was in Chicago last week.

F. H. Soden has been appointed consulting electrician to D. H. Burnham, chief of construction of the World's Fair. Mr Soden is an experienced engineer, and comes to his new position well equipped for the work.

D. B. Dean, manager of the Chicago office of the *Electrical Review*, has resigned to accept a position with the Electric Merchandise company of Chicago. During Mr. Dean's connection with the *Electrical Review* he has gained many friends in the electrical fraternity, who will congratulate him upon his advancement.

Business Mention.

A. H. Zenner of Omaha, Neb., now represents the Electrical Supply company of Chicago, in Iowa, Nebraska, Kansas, and South Dakota.

The firm of Little, McDonald & Co , Buffalo, has been succeeded by F. P. Little & Co. F. P. Little, S. F. Eagan and P. P. Miller comprise the new firm.

W R. Mason, general manager, will represent the Electric Merchandise company of Chicago at the convention of the National Electric Light association at Providence.

The business heretofore conducted by Foree Bain, Chicago, will be continued by the Bain Electric Manufacturing company with increased facilities, at the new factory, 47 and 49 South Jefferson street. Foree Bain is president and engineer.

The Thomson-Houston Electric company has just issued its general catalogue, which is one of the most elaborate ever published by an electrical company. It is published in book form, and the letter press and paper are all that could be desired. The volume is elaborately illustrated with cuts of Thomson Houston lighting and railway apparatus.

The board of directors of the Standard Underground Cable company of Pittsburg, last week organized by electing Joseph W. Marsh as vice-president and general manager; Frank A. Rinehart as secretary and treasurer, and Oscar R. Ebel as auditor. An executive committee was also created, consisting of John H Dalzell, Mark W. Watson and Robert Pitcairn, the president or vice-president being ex-officio members.

Now that Sunbeam lamps can be furnished promptly in quantities the Electrical Supply company of Chicago is finding a marked increase in the demand for these lamps. While the Sunbeam factory facilities were insufficient, a great many orders were necessarily lost, which are now being replaced. The Electrical Supply company is receiving satisfactory reports from the Sunbeam lamps which are now in use in all parts of the country.

The Northwestern Electric Specialty company has a line of devices to which it desires to call the attention of the trade, including wood push buttons, wall sockets, horseshoe cut-outs, oak and locust pins and brackets; also a large and complete line of the latest and most approved styles of iron brackets for electric light work Correspondence or a personal call at the office of the company, at 1017 Chamber of Commerce building, Chicago, is cordially solicited by the manager, George L. Kirkham.

Charles E. Scott, treasurer of the Bristol (Pa.) Electric Light & Power company, says in the course of a letter dated January 29, to Holmes, Booth & Haydens of New York: "All our K. K. lines withstood the storm of Saturday night. In two instances telephone wires rested across the mains without short-circuiting us, and a number of such wires depended from our lines to the ground without showing any ground at the station. In fact, we have never had a break or ground on your wire, and hope that we never may."

At the annual meeting of the Crocker-Wheeler Electric Motor company of New York, held on Jan. 7, the following officers and directors were elected for the ensuing year: S. S. Wheeler, president; F. B. Crocker, vice-president; H. H. Crocker, treasurer; directors, R. N. Peterson, A. F. Higgins, Wm. B. Baldwin, A K. Sloan, David Crocker The annual sworn statement showed a full capital of $100,000, while the total indebtedness was less than $9,000, consisting only of the ordinary open monthly accounts. The statement showed that the business of the company had about doubled during each quarter year.

Interior Conduit & Insulation company, New York, has just compiled specifications for the purpose of enabling architects, builders and other users of conduits to intelligently comprehend the many advantages of the system and to enable them to call for bids upon their work, with the full assurance that they will secure all the advantages of this system. The company requests all to whom the specifications are sent in the interest of themselves and their clients to make no changes in the specifications without the courtesy of an inquiry as to what the effect will be. Assurance is given that the Interior Conduit & Insulation company will either approve the changes suggested, or give convincing reasons for not doing so.

A new switch with porcelain base, and composition cap will be placed on the market by the Great Western Electric Supply company of Chicago. Simplicity, durability and cheapness, are the special points claimed for the device. A new trolley wheel made of aluminum and a secret composition will be introduced by the company. It weighs but about one-third as much as brass, neither oxidizes nor corrodes, and its durability and cheapness, it is said, will commend it to the usage of all electric roads. The celebrated fuse wire of the Massachusetts Electrical Manufacturing company is controlled exclusively in the West by the Great Western Electric Supply company of Chicago. Every ounce of this wire is tested before leaving the factory, and a written guarantee is furnished as to its carrying capacity. The company reports a very large sale for this wire during the past month. The well known K K. and underwriters' wire of Holmes, Booth & Haydens are handled by the Great Western Electric Supply company of Chicago, who probably carry a stock of it larger than any other concern in the country, except the manufacturers.

Two 100-horse power tandem compound Ball engines, manufactured by the Ball Engine company of Erie, Pa., are furnishing power for the new Columbia Electric Light company at the Columbia avenue station, Philadelphia. J. W. Parker, Philadelphia agent of the Ball Engine company, furnished the engines. The Ball company has shipped two 150 horse power tandem compound engines to the Silver Bow Electric Light company of Butte, Mont. The magnificent new Arcade building at Cleveland, O., has its own electric light plant, which is operated by two 100 and one 150 horse power Ball engines The Johnson company of Johnstown, Pa., has just ordered five 60-horse power Ball engines to be used in connection with the large electric welding plant now being put in its extensive works The five 150-horse power tandem Ball compound engines to the Southern Railway company of St. Louis, Mo., have given such such excellent satisfaction that Superintendent Harris of that road has given his order for two more of the same size and style. The Central Passenger Railway company of Louisville, Ky., now using six 150-horse power high speed Ball engines has decided to increase its power plant, and has just sent in an order for four more engines of the same size and style.

Electrical Patents.

Issued February 5, 1891.

445,538. Electric Signaling Device. Samuel J. Burrell and William H. Markland, Brooklyn, N. Y.

445,542. Secondary Battery. Henry T. Cheswright, Carcassonne, France.

445,545. Non-Interference Signal Box. Moses G. Crane, Newton, Mass.

445,546 Electric Arc Lamp. James W. Eaton, New York, N. Y.

A magnet having a differentially-wound coil, one coil being in the main circuit of the lamp and the other in a high resistance shunt of said main circuit, and a pivoted armature and contact point which are placed in a low resistance shunt of the main current.

445,549. Mast Arm for Electric Lights. George Fitch, Sharpsburg, Pa.

445,564. Automatic Circuit-Closing Device for Railroad Signals. Irvin W. Loy and Richard O'Toole, Mechanicstown, Md.

445,583. Rolling Stock for Tramways or Railways. C. Zipernowsky, Buda Pesth, Austria-Hungary.

445 594. Electric Conductor Support. Charles Foster and William H. Bevis, Cincinnati, Ohio.

The invention consists of a clamp adapted to embrace and hold the conductor, in conjunction with other connecting and supporting parts.

445,598. Wire Covering Machine. John McCahey, Providence, R. I.

445,623. Electric Motor. Francis J. Patten, New York, N. Y.

The invention and its operation is based upon the principle combining two motors in one and connecting their circuits in such a way to the same or independent sources of energy that one machine and its circuits is operated by the sucessive positive impulses emanating from one source of energy, and the other is actuated by the corresponding negative impulses from another source of energy, both of which are supplied from a common source.

445 624. Electric Motor. Francis J. Patten, New York, N. Y.

"Claim 5. An alternating current motor having two separate armatures secured to common spindle and independent field magnets for each of said armatures, the exciting circuits of said armature and field magnets being connected in series multiple to the same source of alternating current supply."

445,634. Contact Device for Electric Railways Edward M. Bentley, New York, N. Y.

445,636. Electrical Medical Apparatus. Josephus C. Chambers, Detroit, Mich.

445,648. Apparatus for Electric Branding. William Cannell, Hartford, Conn.

445,653. Electric Semaphore. Frederick Stitzel and Charles Weinedel, Louisville, Ky

"Claim 4. In a semaphore, the combination, with a shaft, a signal blade and a weighted arm secured to said shaft, of an electro-magnet and a pivoted lever controlled by said magnet, with which the weighted arm is adapted to engage to limit its movement."

445,654. Regulator for Electrically-Propelled Vehicles. Sidney H. Short, Cleveland, Ohio.

445,674. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

445,686. Cut-Out for Incandescent Lamps. Turner D. Bottome, Hoosick, N. Y.

445,687. A Symmetrical Electrical Resistance. Turner D. Bottome, Hoosick, N. Y.

445,688. Incandescent Electric Lamp. Turner D. Bottome, Hoosick, N. Y.

445 715. Autographic Telegraph. Harry Etheridge, Pittsburg, Pa.

445,716. Automatic Switch for Autographic Telegraphs. Harry Etheridge, Pittsburg, Pa.

445,721. Telephone Box or Cabinet. Benjamin A. Stevens, Toledo, Ohio.

445,724 Electric Arc Lamp. Otis C. White, Worcester, Mass.

445,727. Electric Gas Lighting Apparatus. Henry H. Cutler, Newton, Mass

445,728 Electric Gas Lighter. H. H. Cutler, Newton, Mass.

445,741. Electric Motor Switch. Franklin A. Weller, Boston, Mass.

445,751. Electric Wire Connector. John W. Hoffman, Pullman, Ill.

The invention relates to electric wires which are used in lighting railway trains between the cars, and consists in certain devices whereby such connections are conveniently made.

445,752. Electric Switch. John W. Hoffman, Chicago, Ill.

The invention provides a switch for electric lighting and like purpose, which will prevent sparking and which shall be efficient in action and simple in construction.

445,770 Method of Electric Soldering and Cementing. Mark W. Dewey, Syracuse, N. Y.

445,771 Apparatus for Soldering and Cementing Cans by Electricity. Mark W. Dewey, Syracuse, N. Y,

"Claim 1. In an electric soldering or cementing apparatus for cans, a movable or rotatable soldering tool and an electric heating conductor in close proximity or contiguous to the tool."

445,773. Electrical Station Indicator. Edwin S. Ely, Chicago, Ill.

445,790. Insulator. Henry D. Winton, Wellesley, Mass,

445,795. Successive Non-Interference Signal Box. Frederick W. Cole, Newton, Mass.

445,796 Electric Visual Indicator. Frederick W. Cole, Newton, Mass.

445,797. Repeater. Frederick W. Cole, Newton, Mass.

445,798. Successive Non Interference Signal Box. Frederick W Cole, Newton, Mass.

445,799 Non-Interference Signal Box. Frederick W. Cole, Newton, Mass.

445,800. Successive Non Interference Signal Box. Frederick W. Cole, Newton, Mass.

445,801. Successive Non Interference Signal Box. Frederick W. Cole, Newton, Mass.

445,802. Successive Non-Interference Signal Box. Frederick W. Cole, Newton, Mass.

445,822. Electric Cut-Out. George A. Scott, New York, N. Y.

445,841. Coupling for the Trolley Wires of Electric Railways. Sidney H. Short, Cleveland, Ohio.

445,860. Apparatus for Testing Metal Pieces Louis de Place, Angers, France.

445,872. Electrode for Secondary Batteries. Sidney H. Barrett, Springfield, Mass.

445,903. Reel for Raising and Lowering Electric Lamps. John T. Roberts, Fort Scott, Kan.

445,906. Dynamo Electric Machine. Carl J. Schwarze, Brooklyn, N. Y.

445,907. Starting Device for Electric Motors. Edward P. Sharp, Boston, Mass

445,908. Trolley Wire Holder. Edward P. Sharp, Boston, Mass.

445,930. Automatic Fire Alarm. John B. Deen, Louisville, Ky.

445,931. Electric Fire Indicator. Thomas R. Douse, London, England.

445,952. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

445,954. Electric Car Lighting. Linwood F. Jordan, Somerville, Mass.

445,957. Electric Switch. George R. Lean, Boston Mass.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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The rubber used in insulating our wires and cables is specially chemically prepared, and is **guaranteed to be waterproof, and will not deteriorate, oxidize or crack**, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and to a very great extent, fire-proof. **Our insulation will prove durable when all others fail.** We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

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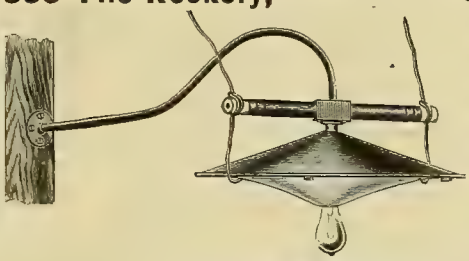

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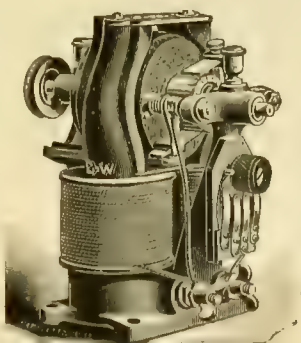

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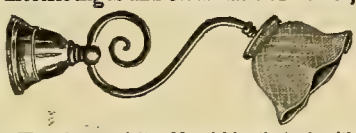

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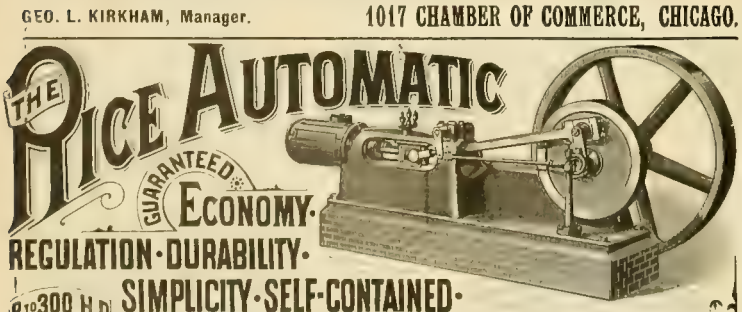

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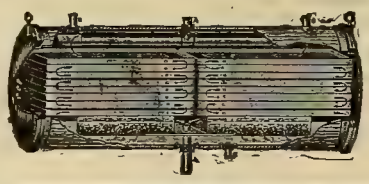

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The motion made by the Pullman company to enjoin the Wagner company and the railroads operating Wagner cars from the use of vestibules is denied, and the Wagner company is sustained on every point it has made in the contest.

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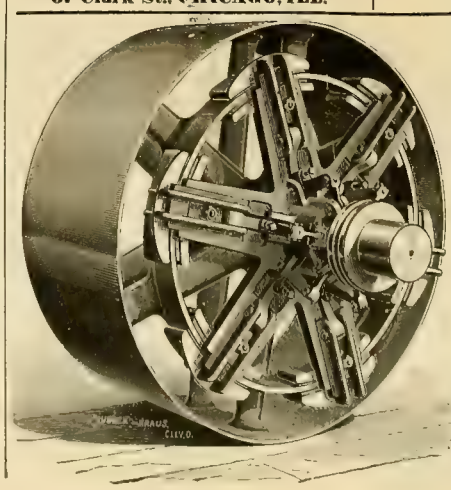

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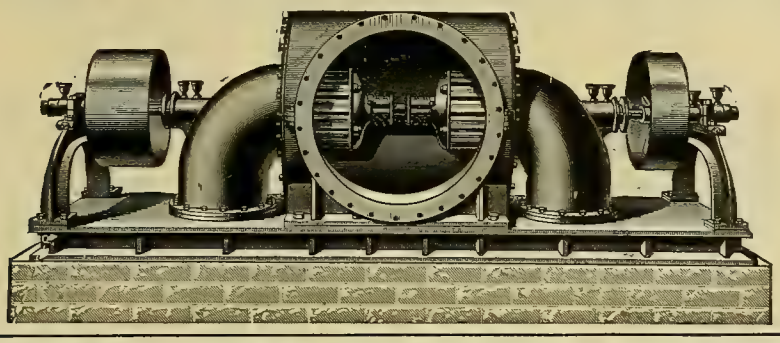

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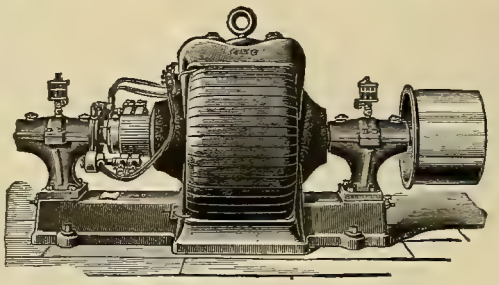

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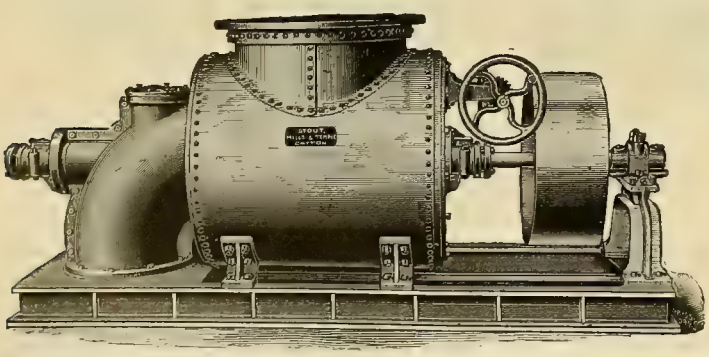

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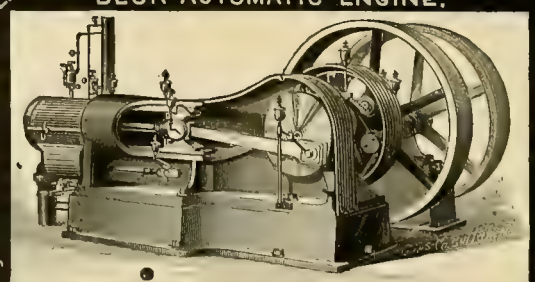

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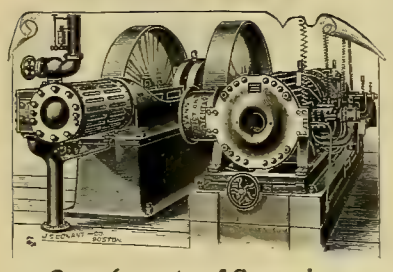

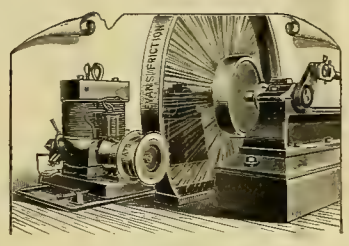

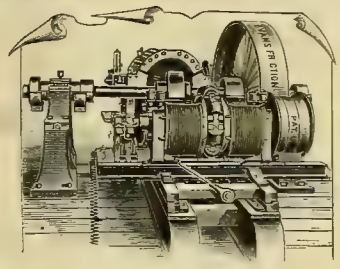

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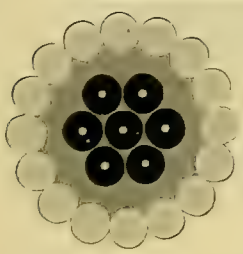

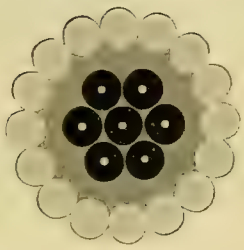

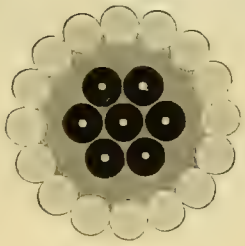

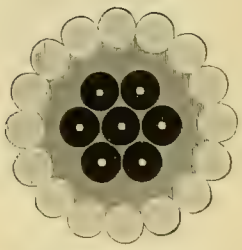

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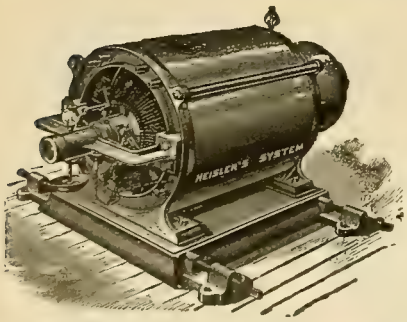

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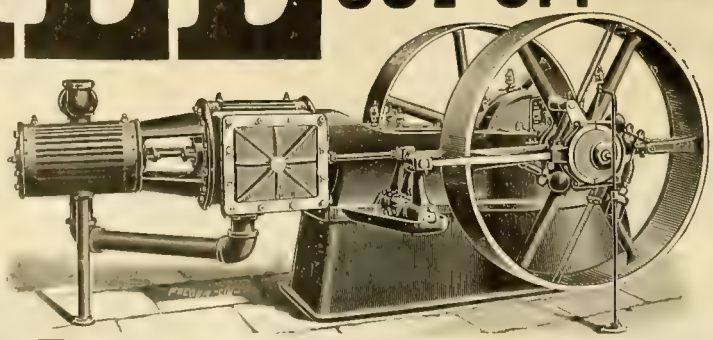

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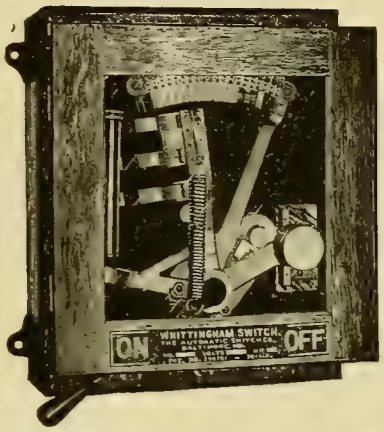

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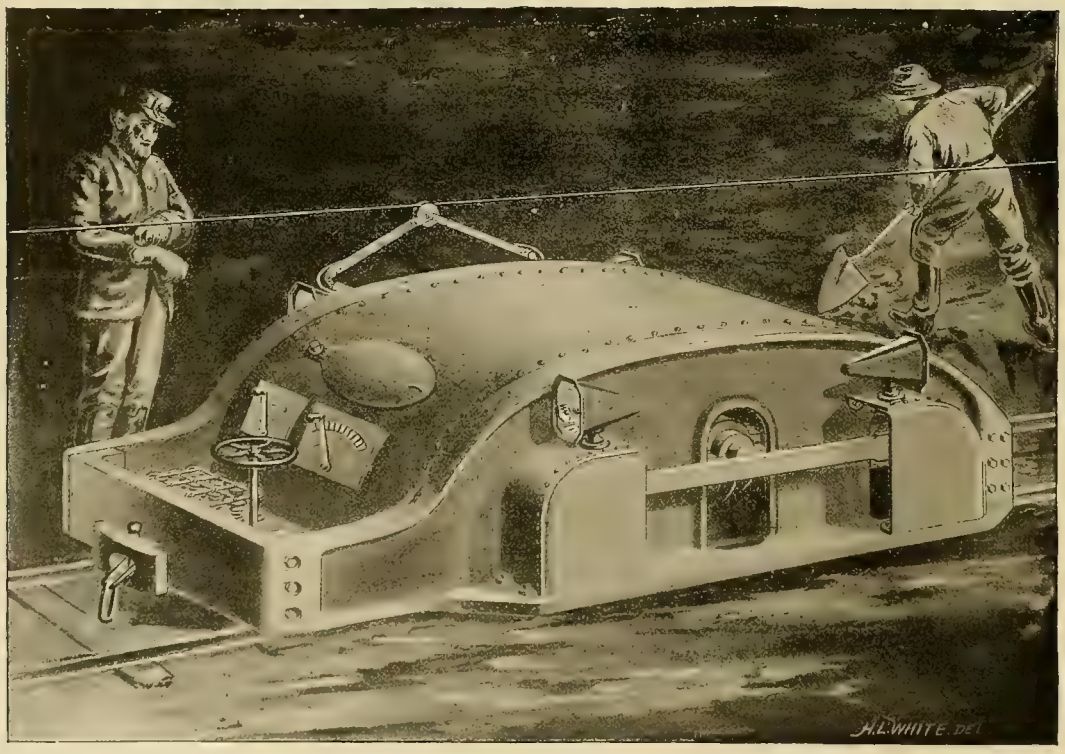

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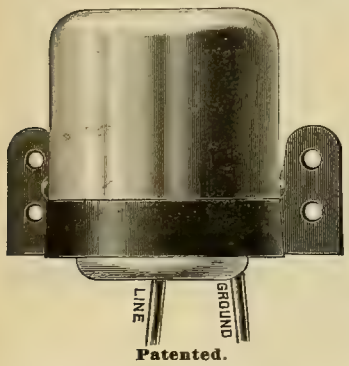

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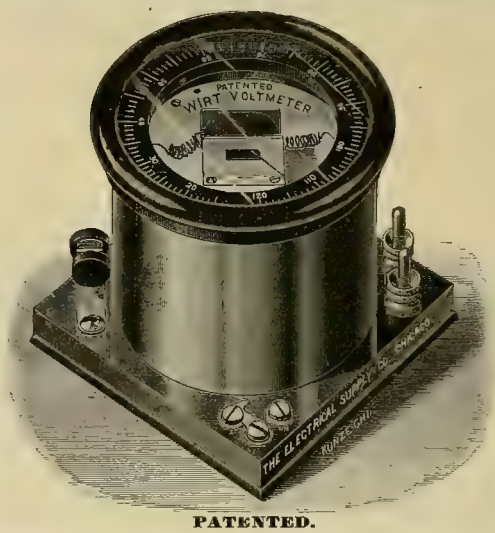

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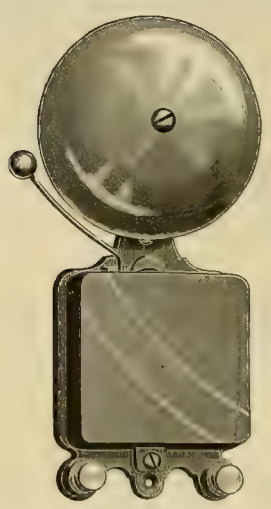

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Accumulators.
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Consolidated Electric Storage Co.

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Manufacturers' Advertising Bureau and Press Agency.

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Empire City Electric Co.
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(See electric railways.)

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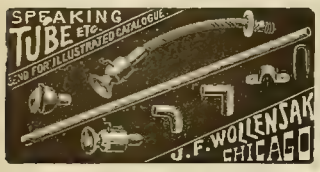

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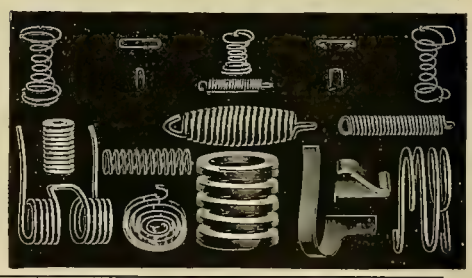

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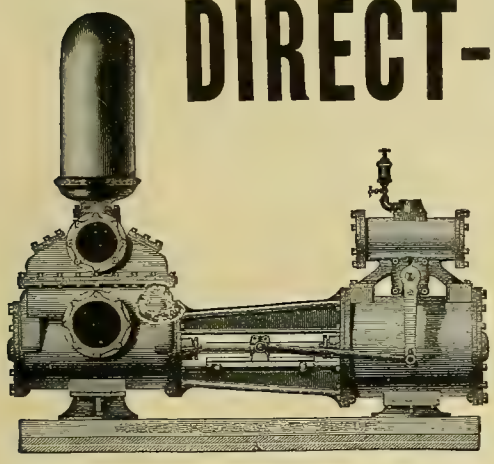

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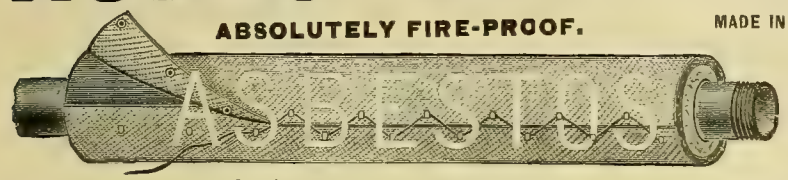

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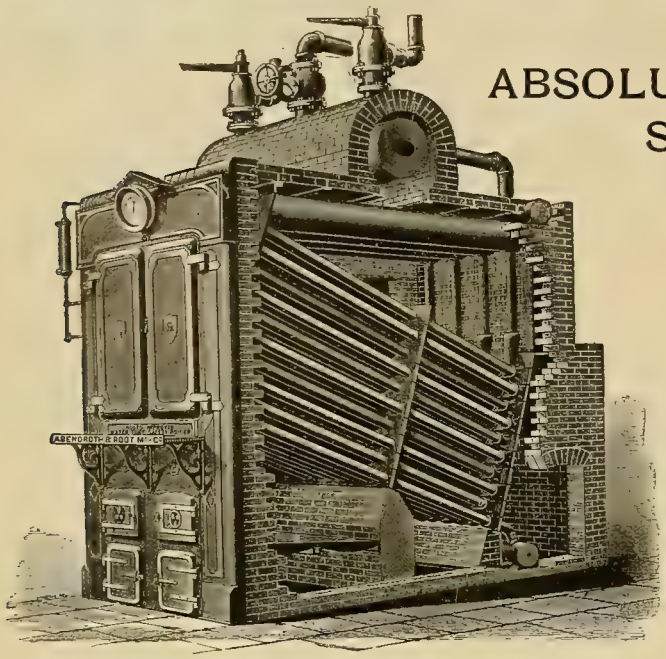

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For the convenience of our customers and the electrical fraternity, we issue from time to time illustrated catalogues describing our stock as it exists at time of publication. We also issue supplements and circulars describing new articles of merit—our constant aim being to inform our friends at earliest possible moment of any new invention or discovery in which we think they are or should be interested. The many complimentary letters we are constantly receiving from the electrical public bear evidence to the fact that our catalogues and circulars fill "long felt wants," and are appreciated.

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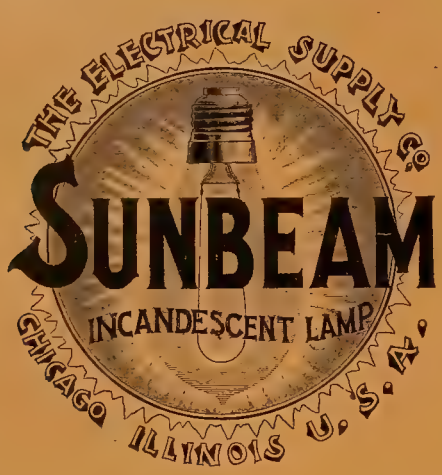
With us always is to merit a continuance of your favors.

THE ELECTRICAL SUPPLY CO.

171 RANDOLPH ST.

CHICAGO.



THE SUNBEAM

INCANDESCENT LAMP.

The lamp that returns most light for a dollar expended in current.

The MOST EXPENSIVE lamp to make.

The LEAST EXPENSIVE lamp to operate.

The lamp that produces a good white light, and is therefore least INJURIOUS to the eye.

Dynamo manufacturers cannot afford to risk the reputation of their machines by using inferior lamps.

Owners of Lighting Stations cannot afford to waste current and handicap their success by using inferior lamps that do not give a satisfactory light.

The public cannot afford to injure their eyesight, and WILL NOT be satisfied with poor lamps when they know "Sunbeam" light can be procured.

SHIELD BRAND

Moisture-Proof Line Wire

For Overhead Lighting Circuits.

For Feeder Wires.

For Power Circuits.

SPECIALLY RECOMMENDED FOR CITY USE.

Tested and approved by Authorities in our largest cities.

BUY THE BEST.

Large Stock constantly carried.

Special facilities for manufacturing largest orders on short notice.

CENTRAL ELECTRIC CO.,

116 & 118 FRANKLIN STREET, CHICAGO.

Connected by Private Wire with Postal-Telegraph Cable System.

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TRADE MARK.

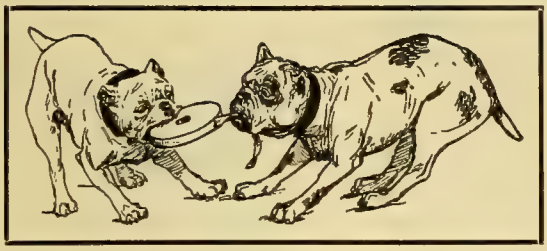
GENERAL WESTERN AGENTS

FOR

Okonite and Improved Candee Wires

AND ALL THE PRODUCTS OF THE OKONITE COMPANY.

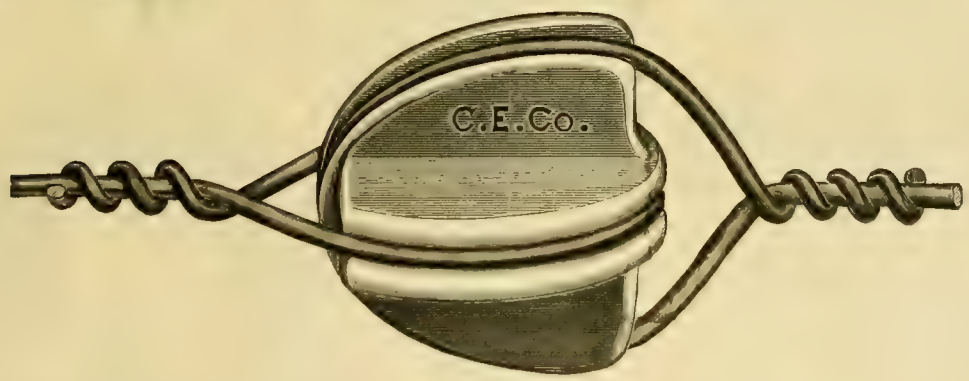
MANSON



TAPE

Is the strongest, cleanest, and most lasting of all insulating tapes.

The Bain Break Insulator.



This insulator is universally commended by Railroad men as the most practical and thorough span wire insulator yet brought to their notice.

We have a full line all kinds of ***ELECTRICAL SUPPLIES****, and have been preparing during the dull months for the spring trade.*

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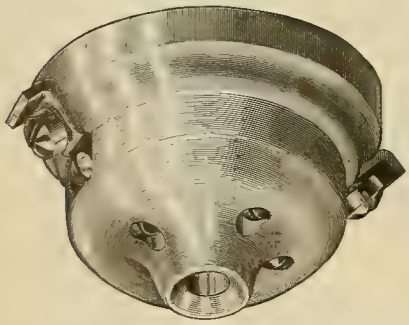

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TO SUPPLY ABSOLUTELY ALL THE

Electrical Specialties used on Earth.

WE ARE MAKING DEALS THAT SELL THE STUFF.
YOU WILL BE "IN IT" IF YOU SEND YOUR ORDERS NOW.

Key and Keyless Sockets, Cut-outs, Single and Double Pole Switches, Gas Attachments, Etc., Etc.

The STAR ELECTRIX COMPANY,

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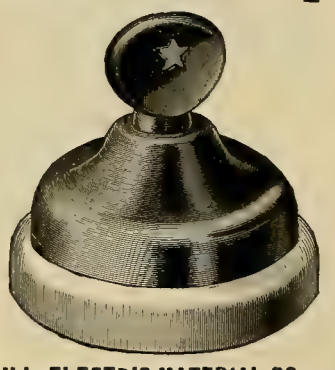

AGENCIES: STANDARD ELECTRIC SUPPLY CO., Boston, Mass. W. H. GORDON & CO., 115 Broadway, New York. ILL. ELECTRIC MATERIAL CO., Rookery Building, Chicago.

AUTOMATIC SWITCH Co.,

No. 8 KEYSER BUILDING,

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WHITTINGHAM AUTOMATIC SWITCH.

The only reliable protector to the Armature of an Electric Motor.

Applicable to Constant Potential Motors of all sizes and patterns.

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ALFRED F. MOORE

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Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

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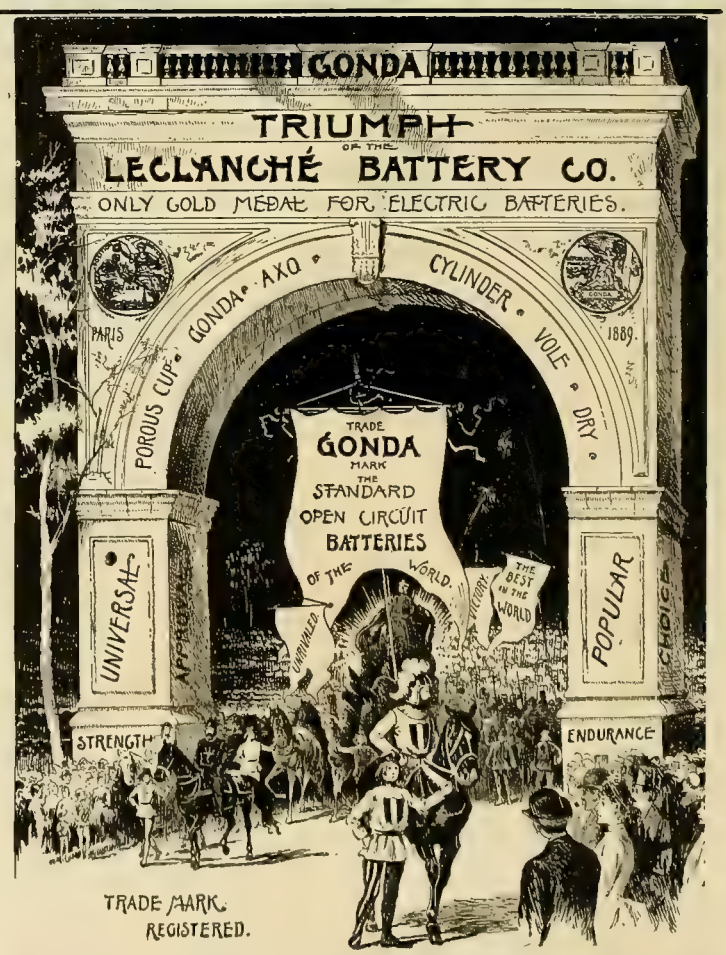
AGENCIES, 926 Drexel Bldg., Philadelphia; 456 Rookery Bldg., Chicago. 111 Water St., Pittsburgh, Pa.

FACTORY: JERSEY CITY, N. J.



For 20 years the superiority of the Gonda Trade Mark Batteries has been recognized all over the world in repeated triumphs over all competitors. Beware of imitations. When you buy a cell for Telephones, Call Bells, Electric Clocks, Gas Lighting, Burglar Alarms, Medical Batteries, Etc., Etc., be sure that it is marked with the word Gonda.

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111-117 East 131st. St., NEW YORK.

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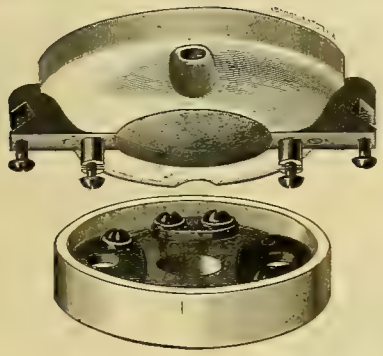
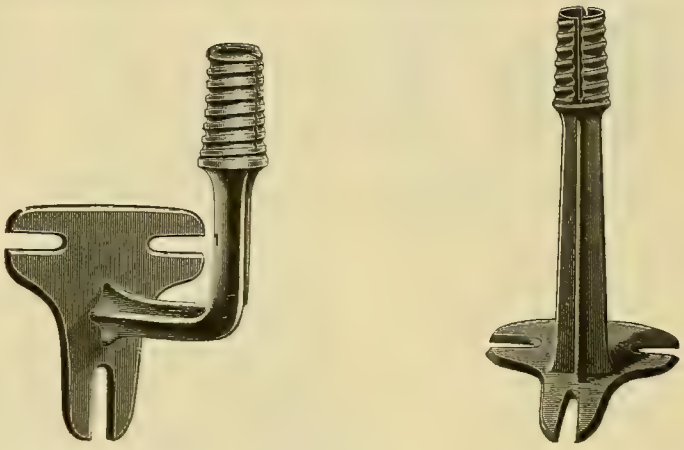
We are General Selling Agents for Holmes-Booth & Hayden's Patent Weatherproof Electric Light, Line and House Wires, which have no superior.



10,000 BRYANT CUT-OUTS,

20 Cents Each.



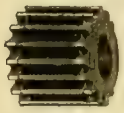
These Brackets never break the Insulators, and always hold them securely.

We manufacture our own porcelain goods, and are able to give you what you want at rock bottom prices.

We are constantly adding new specialties to our already long list. Watch us and keep up with the times.

G. W. RAW HIDE PINIONS.

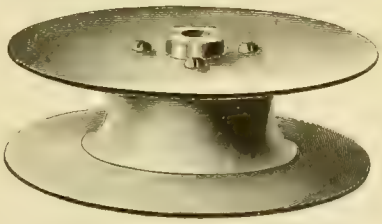
HAVE YOU TRIED THEM?



IF NOT, YOU SHOULD.

They Solve the PINION QUESTION.

G. W. TROLLEY WHEEL.



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One third the weight of Brass.
Best in the Market.

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Detroit Electrical Works

EXPERTS IN THE INDUSTRIAL APPLICATION OF ELECTRICITY.

OWNERS AND MANUFACTURERS OF THE

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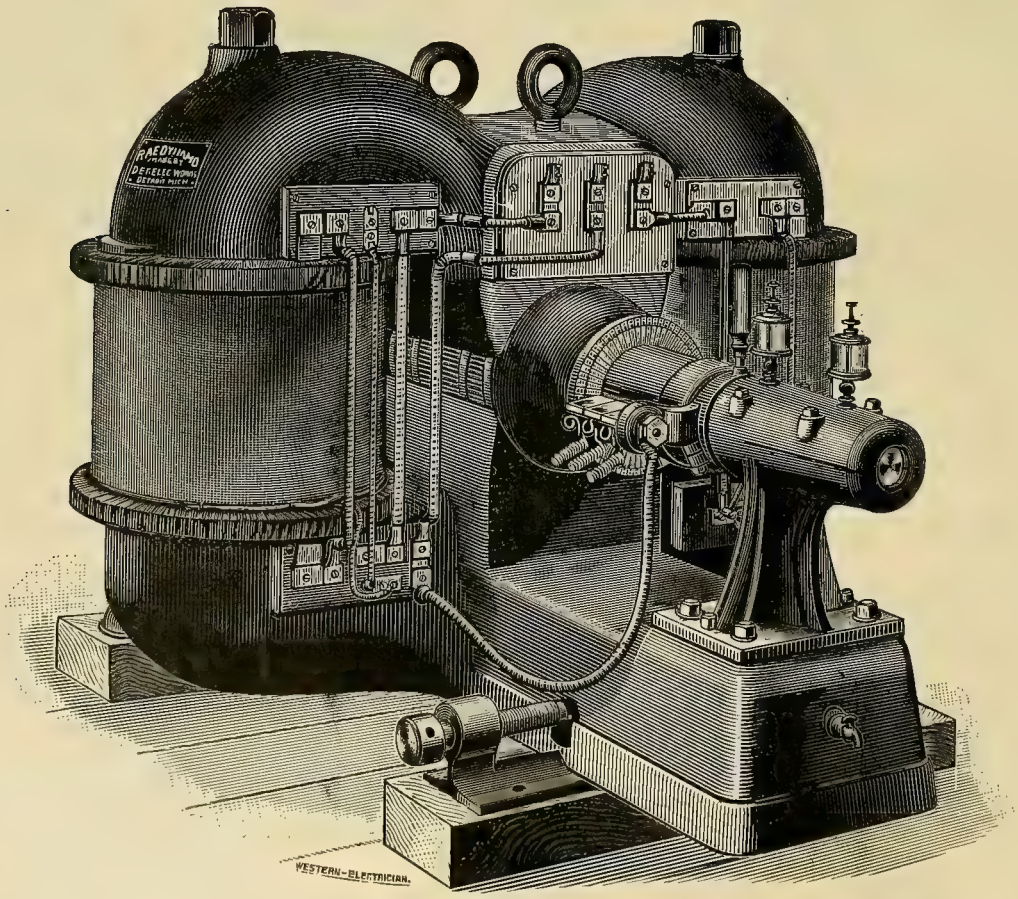
The only system employing a single Motor. Noiseless gearing connecting both axles.



New Standard Compound Wound 80,000 Watt Generator.

Long Distance Power Transmission. Electric Power Plants and Motors.

SEND US DATA AND ESTIMATES WILL BE PROMPTLY FURNISHED.

WORKS, Cor. Woodward and Baltimore Avenues, DETROIT, MICH.

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ARC AND INCANDESCENT LAMPS.

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ELECTRIC RAILWAY POLE.

—MANUFACTURED BY—

MILLIKEN BROS.,

No. 55 LIBERTY STREET, NEW YORK. | No. 59 DEARBORN STREET, CHICAGO.

Standard Side, Center and "Pull-Off" Poles. Special Attention Given to Insulation. Special Poles of any Required Length, or to Stand any Strain Made to Order.

Adopted by all the Leading Roads and Recommended by the Best Engineers.

In use in the following cities: NEWARK, BUFFALO, JERSEY CITY PATERSON, TROY, PITTSBURGH, HAMILTON, O., ETC.

Over 6,000 Ordered in the Last 3 Months.

ORDERS FOR STANDARD POLES FILLED FROM STOCK.

WRITE FOR PARTICULARS.

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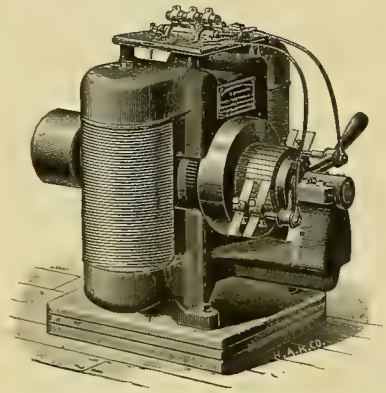

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MOTOR,

The Most Economical Arc Motor Manufactured.

NO BELTS, NO COG WHEELS, NO FRICTION.

A Positive Quick Acting Governor.

Agents Wanted in all the Principal Cities.

The Card Electric Motor & Dynamo Co.,

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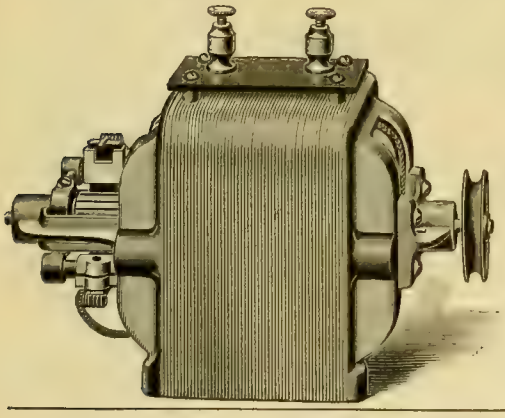

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47 and 49 S. Jefferson Street, CHICAGO.

DYNAMOS AND MOTORS

1-12 to 500 Horse Power.

Highest Class in Efficiency, Mechanical Design, and General Utility.

Experts in applying Electricity to New Uses.

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Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

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L. O. MADDUX, Vice-President and Treasurer.
J. H. EICKERSHOFF, Superintendent.

THIS IS WRONG

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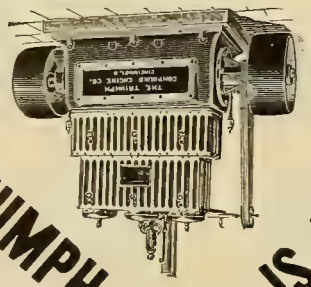

THE TRIUMPH IS ALL RIGHT,

ECONOMY, SIMPLICITY, DURABILITY, SILENCE.

15 TO 300-HORSE POWER. COMPOUND AND VALVELESS.

MOST PERFECT REGULATION EVER OBTAINED.

No Small Parts Requiring Repairs.
No Eccentrics. No Stuffing Boxes. No Piston Rods.
Internal Friction a Minimum.
All Parts Interchangeable.

The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

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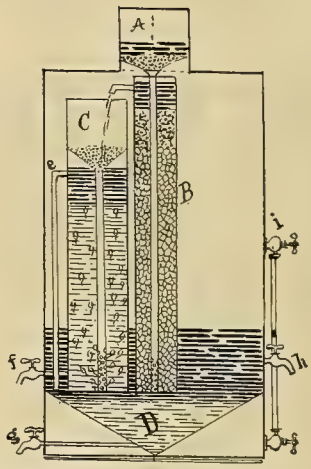
SHIPPED ON 30 DAYS' TRIAL TO ANY RESPONSIBLE PARTY.

ECONOMY IS WEALTH.

TAKE CARE OF THE DROPS,
THE BARRELS WILL TAKE CARE of THEMSELVES.



A Trial will convince the most skeptical that we have the best Filter extant.
Could we ship on 30 days' trial were this not the case?

STANDARD OIL FILTER CO.,

195-207 Canal St., CHICAGO.

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BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

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For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

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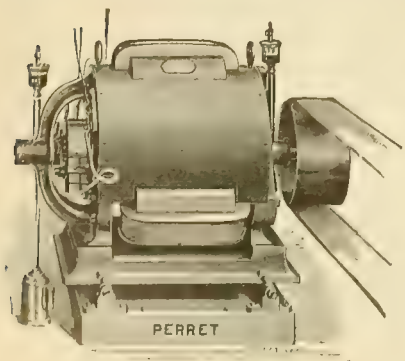

Perret 20 H. P. Motor, Speed 550, Weight 1,300 lbs.

Perret Electric Motors and Dynamos

LAMINATED FIELD MAGNETS, HIGH EFFICIENCY,
LOW SPEED, FULL POWER.

Motors of any size for any purpose. Factories equipped throughout with Electric Power. Isolated Plants for Incandescent Electric Lighting.

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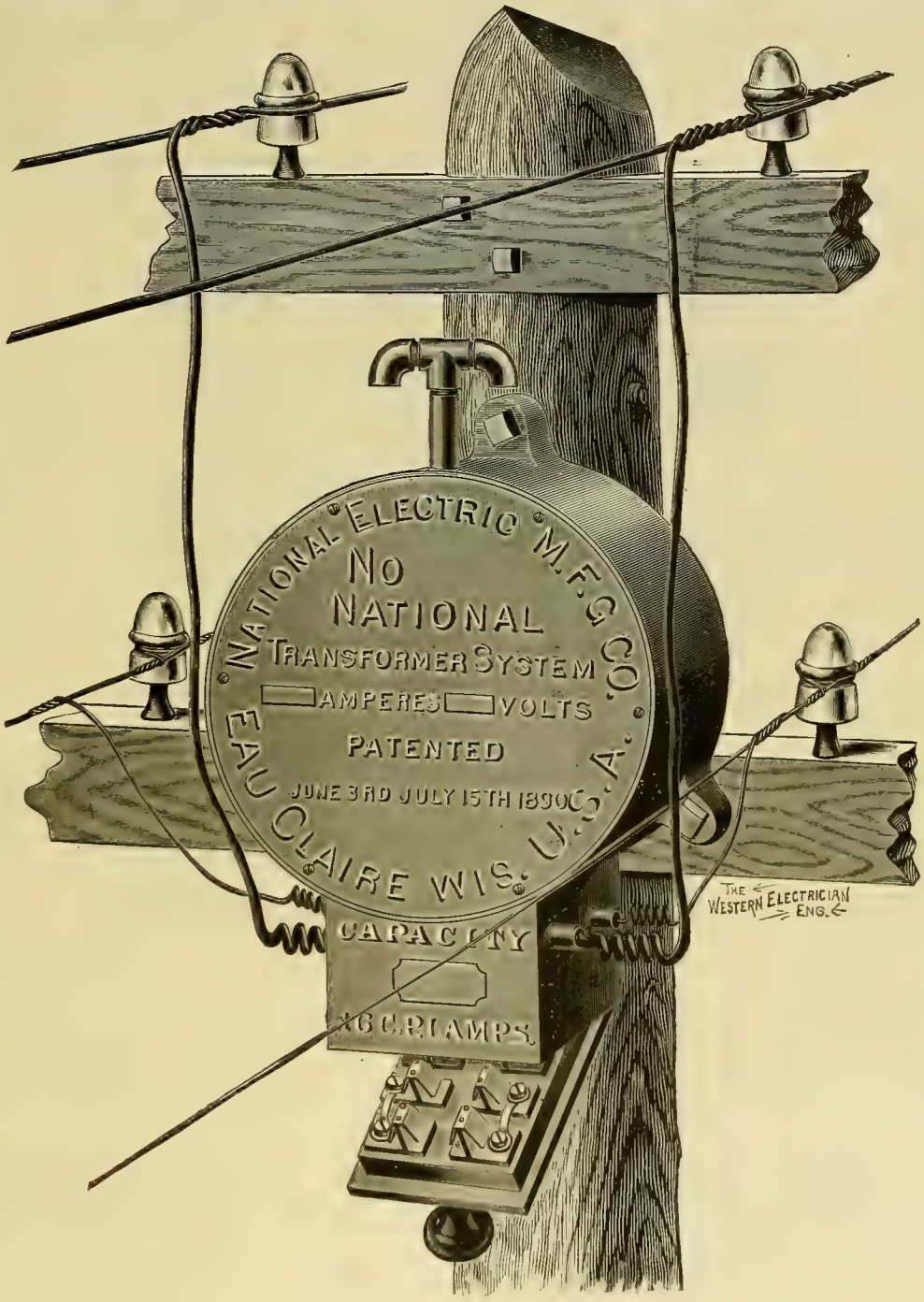
THE NATIONAL TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.

CONVERTER EFFICIENCIES.

It will PAY YOU to throw out your present transformers and substitute OUR MAKE.

No more Accidents from Grounded Circuits.



No more Burnt Fingers or Melted Screw Drivers.

They are the most efficient, {95.2%.} They are absolutely safe. Their regulation is practically perfect.

Transformer on Pole Showing National Safety Fuse Box.

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CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
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OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND
PROTECT OUR CUSTOMERS.

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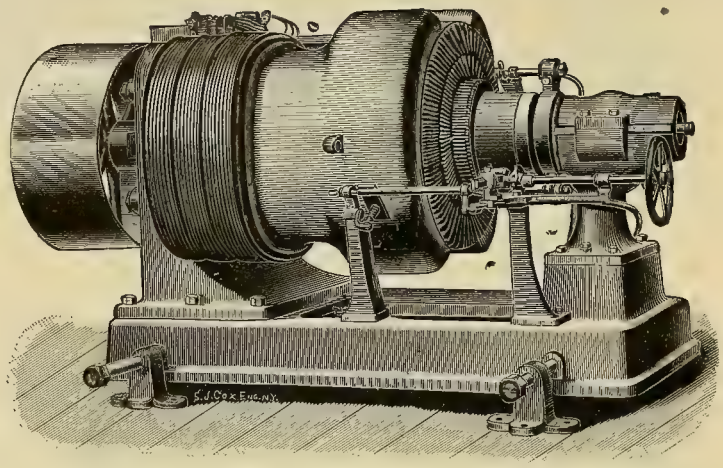
EDISON GENERAL ELECTRIC CO.'S

SYSTEM OF ARC LIGHTING.



Edison General Electric Co.'s 50 Light Arc Dynamo.

THE GENERATOR,

EXCELLENT IN ELECTRICAL DESIGN.

Simple and strong mechanically; Large, well balanced, well ventilated armature; Sectional field windings.
Regulation automatic, regulator simple, and on the machine;
No extra circuits, no wall resistance.

ARC LAMPS,

NEW IN DESIGN.

1,200 and 2,000 candle power; Lamps for 7 or 14 hours' continuous burning as desired.

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THE STANDARD AMMETER.

Weston's Portable Direct-Reading Voltmeter.

Weston's Portable Direct-Reading Ammeters and Mil-Ammeters.

FOR DIRECT CURRENT CIRCUITS.

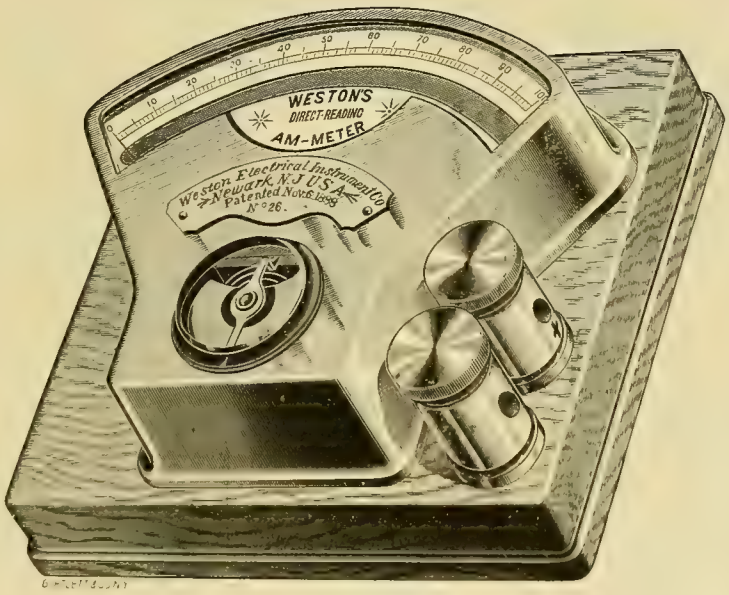
THE WESTON

Standard Voltmeters

— ARE THE —

Best and Most Accurate Portable Instruments Made.

They are perfectly dead beat.
They are direct reading.
They are extremely sensitive, and will indicate to one part in one thousand.



THE WHOLE SCALE

—IS—

AVAILABLE,

— AND —

Accurately Laid Out

—BY—

ACTUAL CALIBRATION.

They have a very high resistance, a matter of great importance.

They are practically **free from temperature error,** the actual difference in their readings being less than **1-4 of 1 per cent.** for 35 degrees, Fahrenheit.

They have no magnetic "lag" and are consequently free from errors arising therefrom.

The temperature error of most of the well-known forms of Voltmeters on the market is about 1 per cent. for 5 degrees Fahrenheit, or 7 per cent. for 35 degrees. The temperature error of such instruments is therefore more than 28 times that of the Weston.

The error from magnetic "lag" of many of the well-known forms of Voltmeters is very high. It varies from 1½ to as much as 14 per cent. The combined errors of such instruments frequently amounts to 15 per cent. when used under ordinary conditions. Such instruments may be "cheap," but it is poor economy to buy them.

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We have tried to overcome these difficulties and to produce a first-class instrument, as perfect in every mechanical and electrical detail as possible, and at a reasonable price, in view of the quality of the instruments.

Over three years' constant use of our instruments proves beyond a doubt that we have succeeded, and that our instruments are perfectly permanent if used with moderate care.

They have been adopted as standards by many prominent electrical companies in this country. They have also been highly indorsed by the **best electricians and electrical engineers** in this country, and by many of the **most prominent electricians** in Europe.

We make 25 different styles, varying in their ranges from $\frac{1}{100000}$ of a volt to 6,000 volts.

The Weston Standard Ammeters and MIL-AMMETERS

possess many of the excellent features of the Voltmeters. We make at present 14 different styles, with ranges varying from $\frac{1}{10000}$ of an ampere to 150 amperes. We shall presently be in a position to deliver higher range instruments up to 30,000 amperes.

Our facilities for repairing and standardizing electrical instruments are excellent, and we are prepared to do such work at reasonable rates.

Weston Electrical Instrument Co.,

OFFICE AND FACTORY,

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CORRESPONDENCE SOLICITED.

OBSERVE THE TRADE·MARK·

OKONITE TRADE MARK ABSOLUTELY THE BEST

INSULATED WIRES AND CABLES

aeriel, submarine and underground.

TELEPHONE, for TELEGRAPH, ELECTRIC LIGHT AND POWER USE.

The OKONITE wires are endorsed and recommended by the most eminent Electrical, Civil and Mining Engineers of the United States and Foreign Countries, and stand unrivalled for their high insulating qualities, durability and extreme toughness.

for INSIDE WIRING OF BUILDINGS and General Railroad and Mining Purposes.

THEY HAVE NO EQUAL.

CANDEE AERIAL WIRES.
MANSON PROTECTING TAPE.
OKONITE TAPE.

Manufactured solely in the UNITED STATES AND EUROPE.

By the INTERNATIONAL OKONITE COMPANY, LIMITED.

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POWER

LONG DISTANCE TRANSMISSION.

WATER POWERS MADE PROFITABLE.
STEAM PLANTS SUPERSEDED.

240 Horse Power furnished at a point seven miles from Generator over a circuit of No. O. B. and S. Wire, loss 15 per cent.
Send us data and we will furnish full estimates of

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WESTINGHOUSE ELECTRIC AND MFG. CO.,

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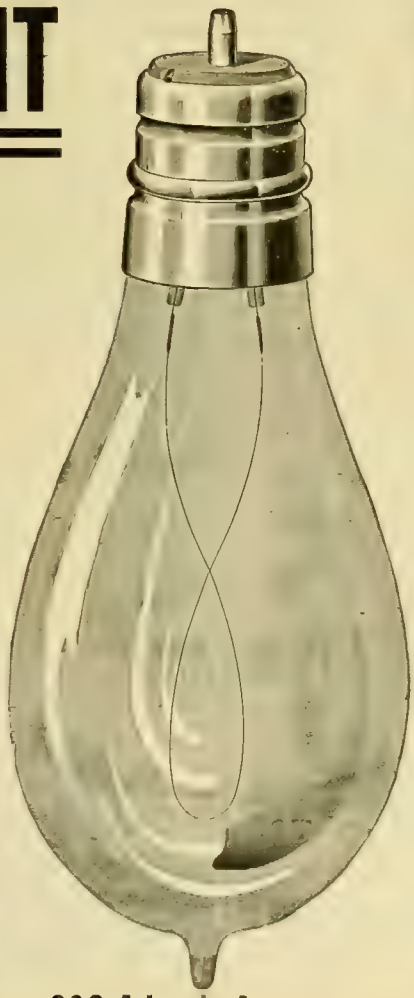
INCANDESCENT LAMPS.



To Fit any Socket.

Excelling all others in Life, Maintenance of Candle-Power and Efficiency.

FROM 8 c. p. to 150 c. p., AND ANY VOLTAGE.

Even Diffusion of Light by twisted filament.

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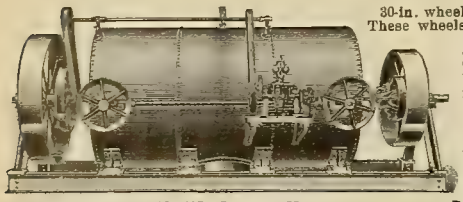

30-in. wheel at Holyoke Testing Flume .9050. These wheels are superior for high power and efficiency, excellent workmanship, even speed and great durability. Tight closing gate; easily operated. Used in many of the largest manufacturing establishments in the United States. 6,800 horse power furnished one mill, 7,200 to another, and one manufacturer 87 wheels. All now running. Special patented arrangements for electric light and power service, even speed, etc.

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ON PAGE XXXIV.

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Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

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PAISTE SNAP SWITCHES.
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—A Quantity of new things to show you.—

—THE—

UNION HARDWARE CO.,

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SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. VIII. CHICAGO, FEBRUARY 21, 1891. No. 8

Narragansett Electric Lighting Company's Station at Providence.

The station of the Narragansett Electric Lighting company at Providence will doubtless be visited by almost every attendant at the convention of the National Electric Light association in that city February 17, 18 and 19. Most of the members are familiar with the plant, as a paper describing it in great detail was read at the meeting of the association at Niagara Falls, August 6, 1889. Mr. Henthorn who read the paper, thought it a model station. He mentioned the fact that the company had started operations in 1884 with 29 lights, but had within five years made such progress that it had constructed a station in which 12,000 horse power might be generated. The credit for this achievement he gave to the general manager and vice-president, Marsden J. Perry, the present president of the National Electric Light association.

The station fronts on the Providence River, and occupies 55,000 square feet. The ground at this point was found to be of an extremely unstable character. The upper crust was solid, but underneath was a stratum of clay which was as hard to deal with as quicksand. Hardpan was reached at depths ranging from 35 to 50 feet below high water. All the permanent walls, it was decided, should rest on piling. The dynamo room foundations are laid on piles varying in length from 35 to 45 feet. These piles, 216 in number, were driven alternately in two rows 32 inches center to center at right angles to the wall and 64 inches center to center, parallel with the wall. Each row was surmounted by hard pine timber pile caps, each 12 by 12 inches. Upon these caps was started the masonry wall, 4 feet 3 inches wide at the base, tapering to 24 inches at the top on the four-foot level above high water.

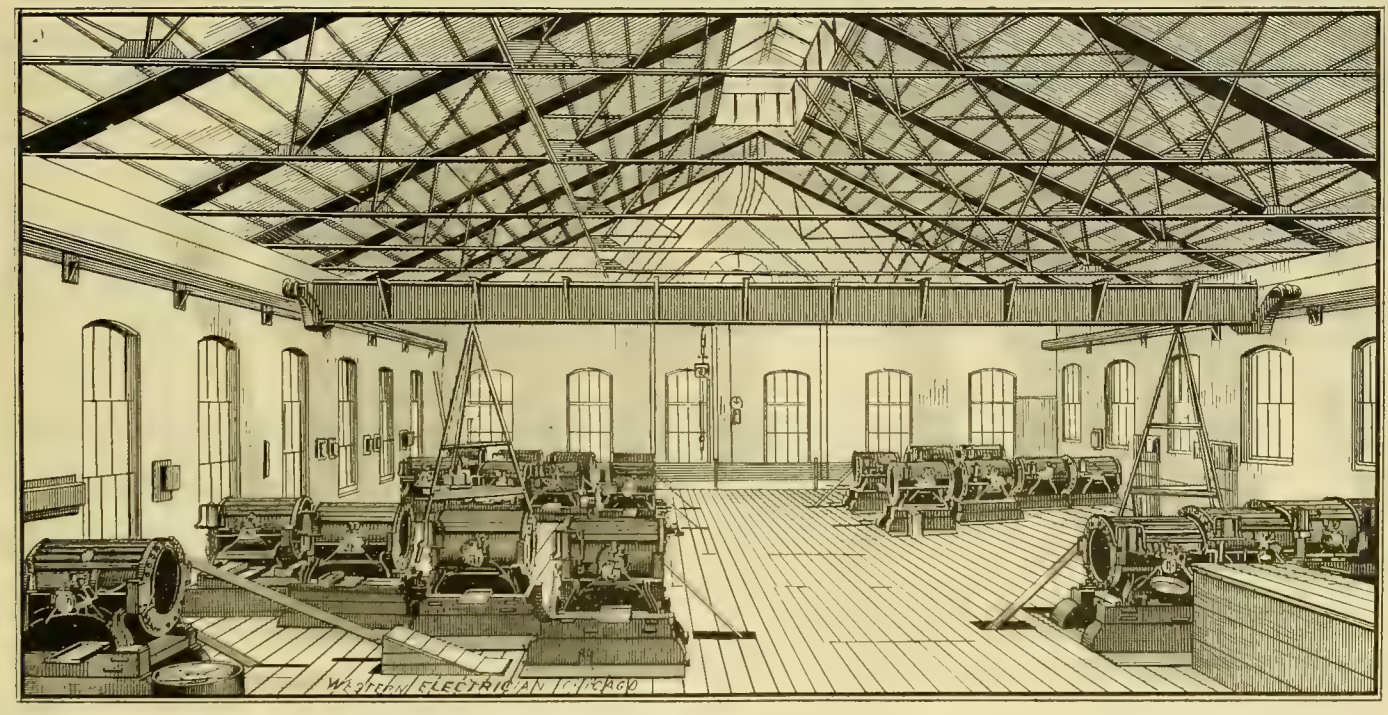
The station was built with a view of constructing additions in the future. The buildings which now comprise the station are a dynamo room, 200 by 60 feet, boiler house 71 by 68 feet, and an engine house 110 by 57 feet. The structures are of brick of plain design. The chimney is 257 feet in height.

The dynamo room is shown in Fig. 1. The company operates 35 Thomson-Houston arc dynamos and 5 Westinghouse alternating current dynamos. Thomson-Houston generators with a capacity of 500 horse power are operated to supply current for 88 stationary motors.

The dynamos are so arranged that a greater number than usual is located on a given floor space. There is abundant room provided however for the inspection of the machines. The dynamos are driven from the main line shaft located below the floor.

The boiler house contains six batteries of Babcock & Wilcox boilers of a total capacity of 2,000 horse power. The coal is delivered to the fire boxes by gravity through chutes from coal pockets on the roof.

The 1,500 horse power triple expansion compound condensing engine is shown in Fig. 2 on the next page. It was constructed by E. P. Allis & Co. of Milwaukee, Wis. The driving belt is 125 feet long, and is 6 feet wide. The second engine is compound condensing and was built by the same company. An auxiliary Armington & Sims 150 horse power engine is also operated.



NARRAGANSETT ELECTRIC LIGHTING COMPANY'S STATION AT PROVIDENCE—DYNAMO ROOM.

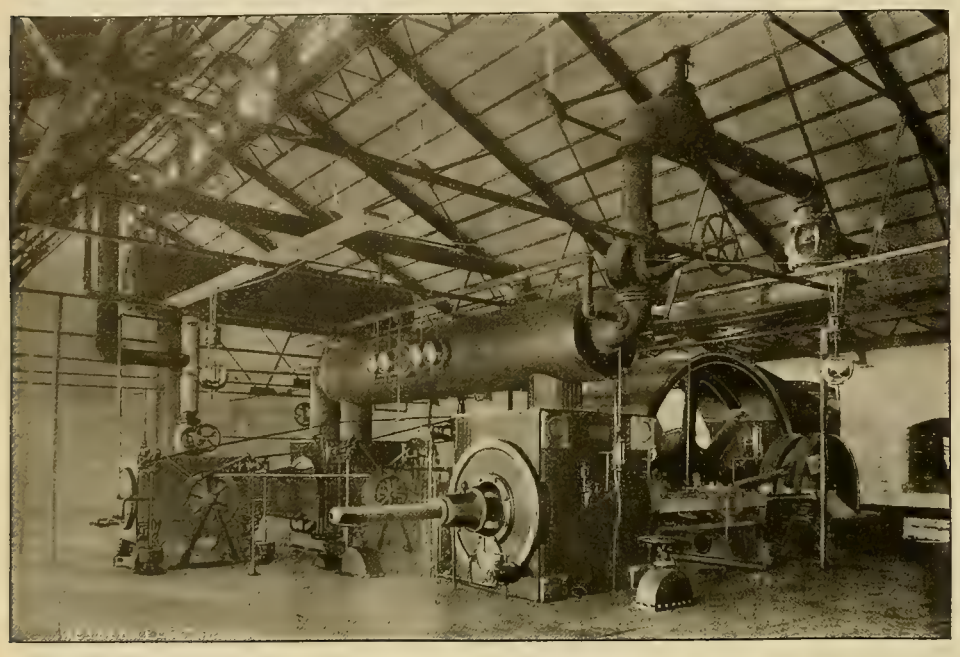
Electric Lighting and Building.

The Masonic Temple of Chicago, in which there is so much interest throughout the country, will be a most remarkable building not only on account of the immensity of its size, but also from the fact that from the day on which it was begun, Sundays excepted, until it is completed, work will be continued if the plans of the contractors and trustees are followed. It was of course determined to have the building in readiness at the opening of the World's Fair, and to do this it was deemed advisable to put three gangs of men at work, and keep them engaged constantly until completed. This could only be done of course by the aid of electric lights. At present there are twelve arc lamps employed. They are furnished by the Chicago Arc Light & Power company, and are operated day and night. The work of excavation is progressing rapidly by the aid of these lights. The workmen are protected from the inclemency of the weather by a temporary waterproof inclosure covering the site of the proposed building. When the excavation is completed and the foundations laid, the covering will be raised so that the walls can be built up to the first floor, then to the second and so on until the entire building is completed. During the recent "cold snap" in Chicago, when operations on all other buildings were discontinued, the workmen found no difficulty in continuing their operations. This of itself is an interesting fact, and will attract the attention of builders to the scheme.

More Litigation over Double Carbon Arc Lamps.

There has been developed during the last week a new feature in the litigation over the double carbon arc lamp patents. It will be remembered the Brush company secured several injunctions restraining other companies from manufacturing, disposing of or operating double carbon arc lamps on the ground that all such lamps infringed the Brush patents. One of these companies was the Western Electric company of Chicago. This company immediately placed what it claimed was a new form of lamp upon the market. The first order filled was that for the new station of the city of Chicago. The Brush company took up the matter at once and

proceedings for contempt were instituted against E. M. Barton, C. A. Brown, J. M. Jackson and George P. Barton, representing the Western Electric company. The Brush company claims that the new lamp of the Western Electric company is identical with that manufactured by the company before the injunction was issued, but the respondents assert that radical changes have been made and that the new lamp in no way infringes upon the Brush patents. The case was argued before Judges Gresham and Blodgett last week at Chicago. Decision was reserved.



NARRAGANSETT ELECTRIC LIGHTING COMPANY'S STATION—THE 1,500 HORSE POWER ENGINE.

Revival of the Cushman Telephone Claim.

The American Bell Telephone company of Boston recently began a suit against H. E. Chapman of Chicago to secure an injunction restraining him from manufacturing and selling telephones alleged to be infringements of the Bell telephone patent. On February 9th Judge Blodgett of the United States court for the Northern district of Illinois handed down a decision granting a preliminary injunction. The suit, if the attorneys for the defense carry out their plans, will be a most interesting one. The defense claimed that the Bell patents were void because of the work which was done in the same line by Dr. Sylvanus D. Cushman in Racine in 1851. This ground, in fact, was substantially all the defense. The case will involve a reconsideration of Dr. Cushman's claim that he was the original discoverer of the telephone.

Dr. Cushman's claims, it will be remembered, were passed upon by Judge Blodgett in the case of the American Bell Telephone company against the American Cushman company. He decided that against the defendant in that suit on every point.

In granting the preliminary injunction in the Chapman case, Feb. 9, Judge Blodgett defined Dr. Cushman's work in these terms:

That Dr. Cushman did make some instrument which connected a shop with the telegraphic office through which the boys talked, and which were on exhibition there for a little time, and that such an instrument was used there and in a place where he made lightning rod wires or twisted them together some time afterward, must, I think, from the testimony be considered as established. But it stopped there. The fact still exists that Dr. Cushman gave nothing to the world; He produced nothing. Whatever he did was ended there. He never made a practical telephone which the world was willing to accept or which ever excited the interest of men of science or of practical men with regard to its principles and application. He stands, so far as this great discovery which is exhibited in the Bell telephone is concerned, where the Northmen stood in regard to Columbus concerning the discovery of America. They coasted along the shores of England and Labrador three or four hundred years before Columbus set sail on his voyage of discovery, and no doubt saw land, and landed and made brief settlement. But they did not give this continent to the world. Columbus came and carried back the news which stimulated the ambition and zeal and enterprise of the whole civilized world at that time, and gave this hemisphere to civilization. That is the difference between Dr. Cushman, whose work stopped there where he found it, having discovered that something could be done in the way of transmitting sounds, but never making a practical use of it, and Bell, who has given us a practical telephone. It was nearly forty years after—over thirty years after—that the world was taken up by another inventor with no knowledge of what Dr. Cushman had done, and was perfected to the present stage of efficiency. Referring to the same parallel I have already used, if Columbus had stopped his discovery with his visit to the little lone island that he first touched and he had never made another voyage, the parallel between him and Dr. Cushman would have been the same. The world would not have got anything from Columbus' discovery, except there was a little lone island out there in the Atlantic Ocean which could be reached by sailing westward—from Spain to Portugal. But he made further voyages himself; and whether he touched the main land or some other person touched it first is of no consequence so far as the giving of the great discovery to the world is concerned. Dr. Cushman was content with the little spot he touched and stopped there and he gave nothing whatever to the world. This seems to me to be a fair illustration of Dr. Cushman's relation to the art.

It is expected that the Chapman case will come up for a final hearing in June. The case will then be taken to the Supreme court of the United States. An effort will be made to secure from that court a special order for advancing the case so that a decision may be reached before the expiration of the Bell patents.

Dr. Cushman's claim to the discovery of the telephone is doubtless familiar to all readers of the WESTERN ELECTRICIAN. The discovery, the doctor says, was accidentally made when he was a resident of Racine in 1851. He was constructing a telegraph line from Racine to Beloit. When the line reached a swamp near Rochester work was suspended, and Dr. Cushman states that he constructed peculiar lightning arresters for the line which he found transmitted sound over the wire. The croaking of frogs in the swamp was heard, he states, in Racine. The device he subsequently employed, he alleges, for a useful purpose.

Slattery's Secondary Battery Electrode.

"An electrode for secondary batteries formed of finely divided pure copper compressed into a coherent mass."

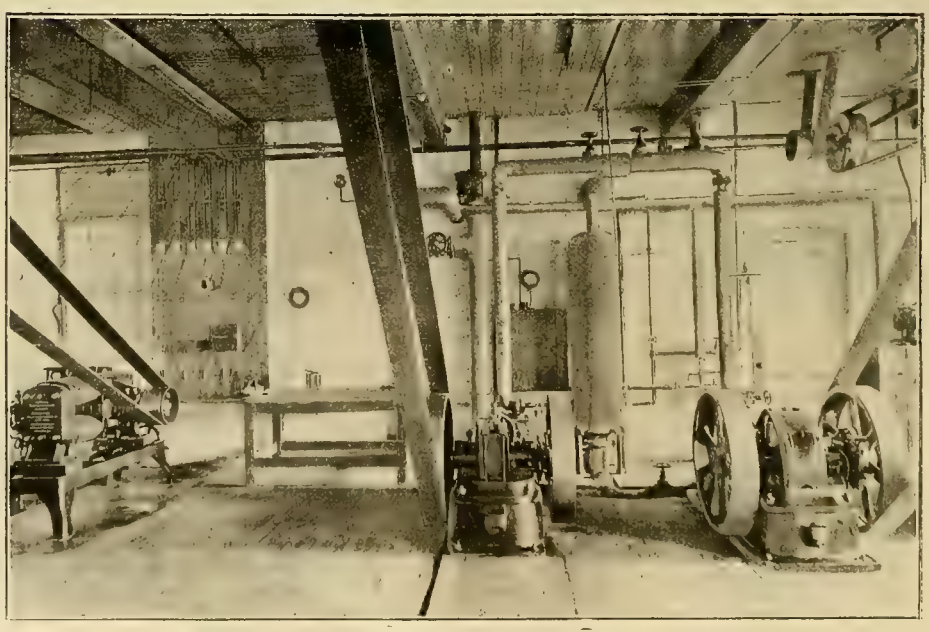
These are the words by which M. M. M. Slattery of Fort Wayne, Ind., describes one of his latest inventions.

The plate is made of copper, and is used in connection with an alkaline solution and another electrode, which may be of iron. In making the copper electrode very finely divided copper in a pure form is used, such, for instance, as is obtained by electrical reduction from the oxide and which is in an almost impalpable powder. The copper in this state is placed in a mould and compressed by hydraulic pressure until the copper powder is squeezed into a coherent mass or plate of a density and strength sufficient to allow of its manipulation, and used as a battery plate.

Such a plate has a formation more porous than that of an ordinary solid copper plate, and the principal advantages claimed for it are its unoxidizable character; its lightness; its capacity for absorption of gas and liquid; and its permanence.

Two Providence Electric Light Stations.

Two isolated electric light plants in Providence are illustrated in the accompanying engravings. In Fig. 1 is given a view of the plant in the works of the Gorham Manufacturing company at Elmwood. The factory has a frontage of 1,000 feet and 1,100 men are employed. The two Edison dynamos shown in the engraving are each of 750 lights' capacity. They are operated from a countershaft driven by the Corliss engine which furnishes the power in the factory. In the cellar are located two Edison dynamos which supply the current for electro-plating. They are operated by an Armington & Sims engine. The Gorham company has extended to members of the National Electric Light association a cordial invitation to visit its works when they are in Providence.



ELECTRIC LIGHT PLANT OF THE PROVIDENCE LITHOGRAPH COMPANY.

Fig. 2 gives a view of the electric light plant in the factory of the Providence Lithograph company. Two Armington & Sims engines operate a Weston dynamo, and furnish power throughout the establishment.

The Bayfield, Wis., Lighting company has installed an incandescent plant with a capacity of 2,500 lights for public and commercial lighting.

Improvements in the Station of the Chicago Arc Light & Power Company.

Such has been the growth of the electric lighting business during the last few years that in many cases station managers are now finding that their machinery is, or soon will be, totally inadequate for what is expected will be the natural growth of next year's business. As a consequence of this encouraging outlook, a number of the lighting companies are remodeling their plants. Among the companies making changes of an extensive character is the Chicago Arc Light & Power company. This company, as is well-known, started business with a number of isolated plants located at different points throughout the city. The first improvement was to bring together under one roof at 76 Market street, all the apparatus from the several isolated plants, so as to supply all the lamps from one large central station. It was soon seen, however, that the Market street quarters would have to be enlarged. Accordingly, when a short time ago, an opportunity presented itself, to obtain control of another large portion of the Market street building, adjoining the station, no time was lost in commencing to enlarge the old quarters.

The readers of the WESTERN ELECTRICIAN have already had presented to them a full description of the Market street plant, so a few words will suffice to make clear what the changes are to be.

To begin with the steam plant, the boilers will all be new and of the Manning upright type. The boilers and engines will be on the ground floor, with the condensers in a sub-basement. The dynamo room will be just above the engine room, and on the third floor three lines of shafting are to be located. By this arrangement the engines belt up through two floors to pulleys in the shafting room. From the shafting room power is transmitted by belts down to the dynamos, on the next floor below. Rope transmission will be employed only between the engines and the shafting. From the shafting to the dynamos belts will be used. Work on the improvements is being pushed, and it is expected that the remodeled station will be so complete in its arrangement that little, if any, change will be required for years to come. The capacity of the station when completed will be 5,000 horse power.

Electric Railway Litigation at Milwaukee.

The injunction which was secured by the Milwaukee City railroad against the Whitefish Bay company to prevent the latter from erecting poles and stringing wires on Broadway was dissolved February 9 by Judge Winslow of Racine, in the Superior court. During the struggle for supremacy last spring between the Whitefish Bay people and the roads that are now owned by the Villard syndicate, the former attempted to score a point by erecting poles and stringing electric wires on Broadway, which was already occupied by the Milwaukee City company with a horse line. An injunction was obtained and the half-dozen poles with their few hundred feet of rusty wire have stood as a mute protest against the slow movement of the wheels of justice. In his decision Judge Winslow says that the Milwaukee railroad company's claim, that the portion of the original ordinance which reserved the right to grant other companies permission to use its tracks was void and untenable and that the city had no power to attach claims to the plaintiff's charter, is not well taken, and if such were not the case the whole ordinance would be void. Judge Winslow says that the charge made by the Whitefish Bay company that the Milwaukee City road did not begin the equipment of its road by electricity within three months, as required by the ordinance, has been "skillfully evaded rather than satisfactorily met."

Under the decision the two companies become tenants in common of the franchise and the Milwaukee City road will, it is said, undoubtedly rent the use of the Whitefish Bay company's power along the five blocks on Broadway from Martin street to Michigan street. The attorneys of the Whitefish Bay line said lately that work on that road would be begun in earnest at once and pushed to completion. Henry C. Payne, who represents the Villard interests, said the fight would not be given up, as the case would be taken to the Supreme court.

Electrical Section of the World's Fair.

Following are the resolutions adopted by the Chicago Electric club at its last meeting regarding the electrical section of the World's Fair:

WHEREAS, The question of location of the electrical exhibit and display in the proposed World's Columbian Exposition is one of the greatest importance to the electrical interests of the country and

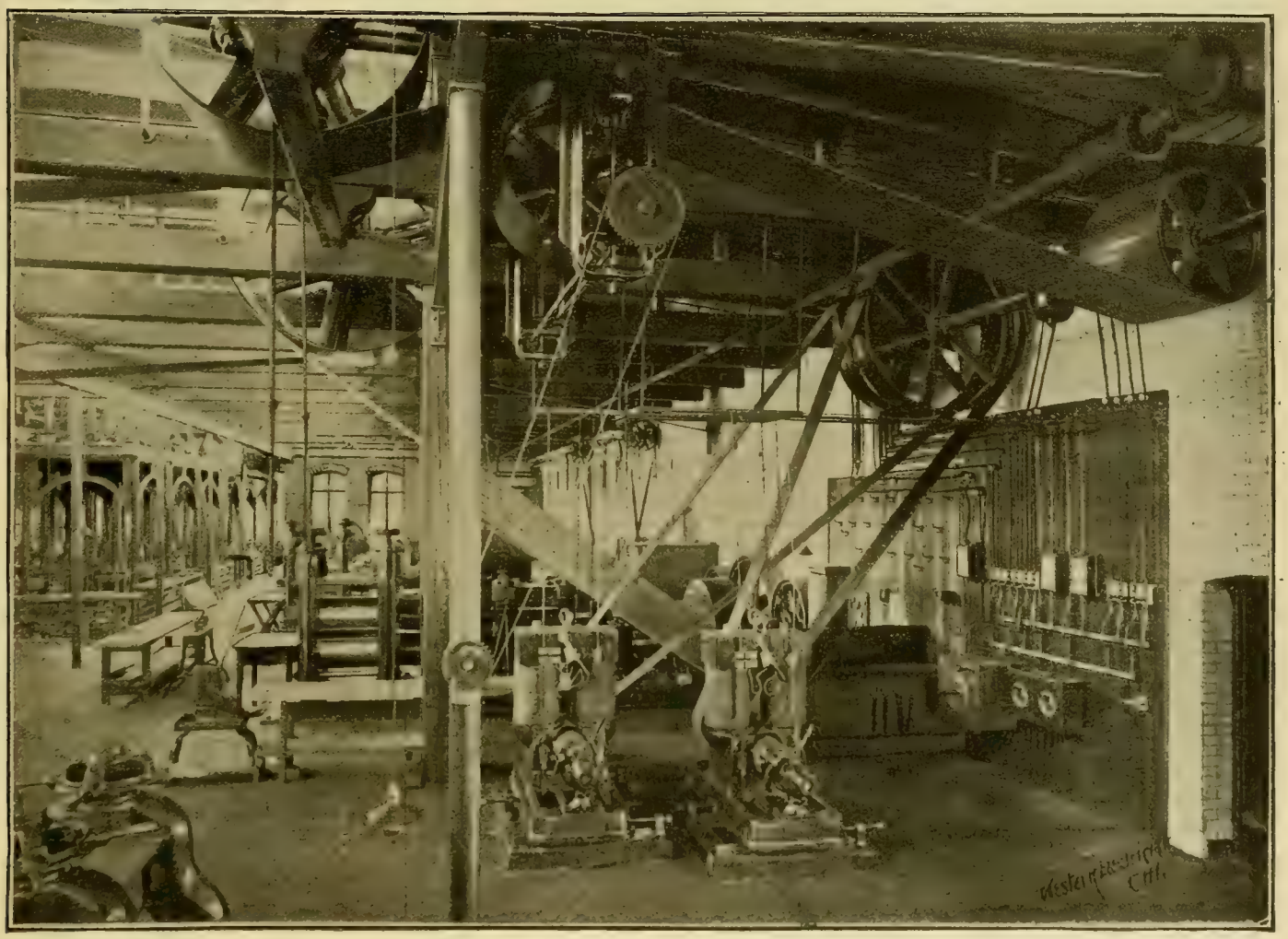
WHEREAS, It is generally understood that the directors of the Exposition contemplate dividing the exhibit and display, placing one on the Lake Front and one in Jackson Park, and

WHEREAS, This body being composed of representative men from the most prominent electrical interests of the United States, realizing the immense importance of the electrical portion of the proposed Exposition, and wishing to make the same as impressive and attractive as possible, it is

Resolved, That in the opinion of the Chicago Electric club the best interests of the general public and the electrical industries will be subserved, and a satisfactory exhibit more certainly assured by placing the entire electrical exhibit in one place. Be it further

Resolved, That in the opinion of this club, the amount of steam power and space required for the electrical exhibit or display will render it impracticable to place either on the Lake Front, and that all should be located at Jackson Park.

Resolved, Further that this club most respectfully request the authorities of the World's Columbian Exposition to give this matter their favorable consideration.



ELECTRIC LIGHT PLANT OF THE GORHAM MANUFACTURING COMPANY, PROVIDENCE.

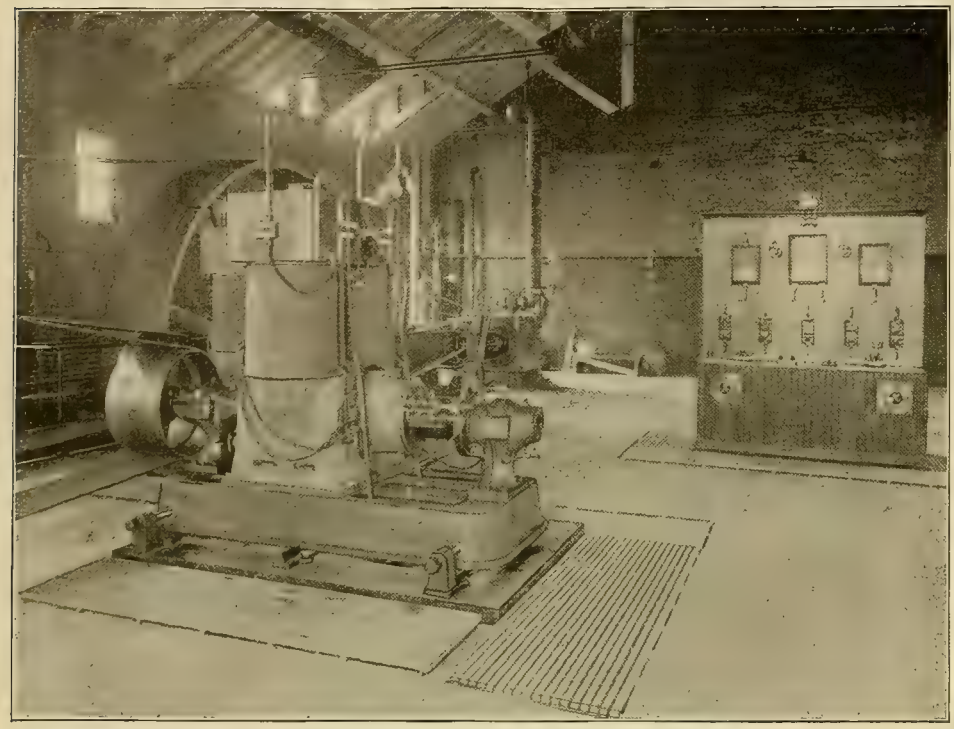
The demand for electric railways has so crowded the manufacturers of this line of machinery that there is a general delay in equipment of new roads. The Rochester, N. Y., Street Railway company, which is equipping its entire system with electrical apparatus, has been waiting for months for its engines and boilers. Only a comparatively few cars are operated in consequence of this lack of power.

Cicero & Proviso Electric Railway.

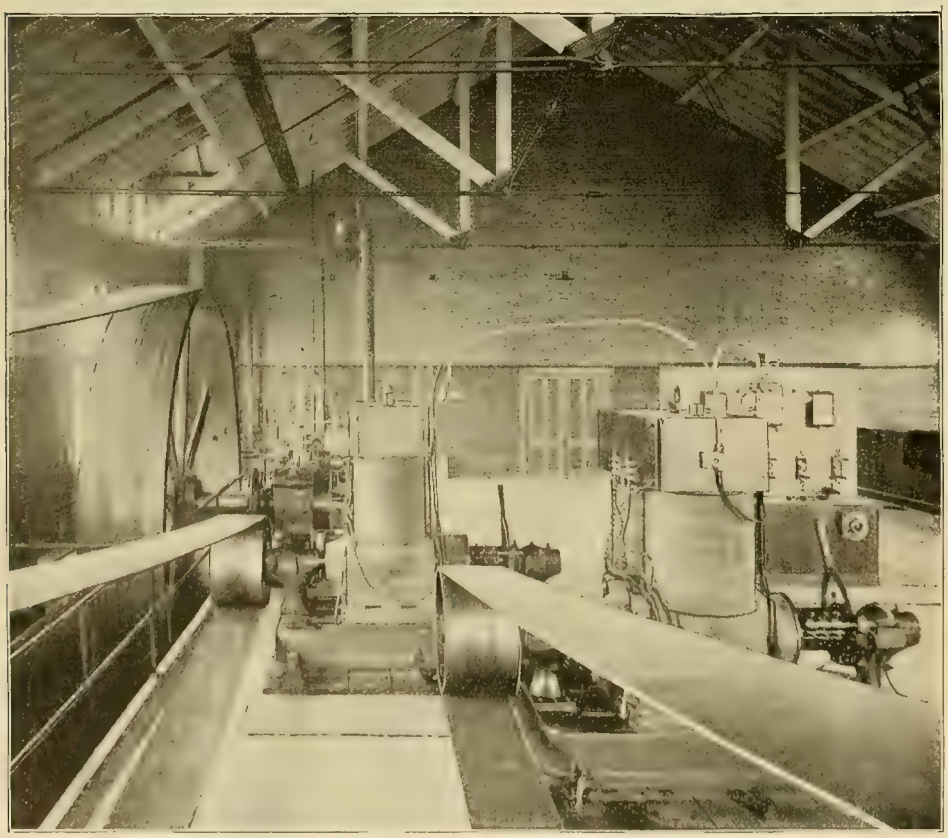
The generator room of the Cicero & Proviso Electric Railway company's power house in Chicago is illustrated in the accompanying cuts. This company was organized about a year ago and work was begun last spring. The line is practically an extension of the Madison street cable line of the West Chicago Street Railway company, though operated by a distinct company. It extends from the end of the cable line out Madison street to Harlem avenue, thence to Lake street and back to the old city limits. Connection at this point is made with Madison street. Both Madison and Lake streets are double-tracked, while the cross lines on Harlem avenue along the "old city limits," which are very short, are only single track lines.

The power house, at present, has only two 80,000-watt generators, but there is ample room for material extension. The generators are driven by a 250-horse power Corliss engine, belted direct. The route established by the company is eight miles in length. Twelve cars will be operated for a time, until more are demanded. The plant was installed by the Edison General Electric company, Chicago department.

Since the boundaries of the city of Chicago were extended land in this part of the town has been boomed by real estate investors. It is one of the most desirable sections of the city. The residents of that part of the town have been obliged to depend upon a "dummy" line heretofore operated by the Chicago, Harlem & Batavia Railroad company, and the lack of rapid transit, of course, impeded the the progress of the locality. Now, however, real estate men look to a boom in that part of the town.



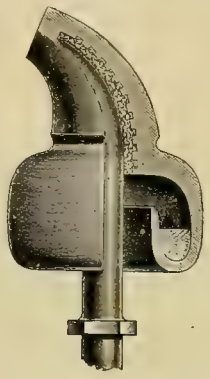
CICERO & PROVISO ELECTRIC RAILWAY, CHICAGO—GENERATOR ROOM.



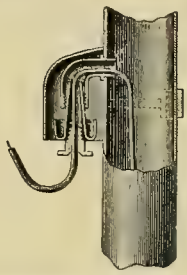
CICERO & PROVISO ELECTRIC RAILWAY, CHICAGO—GENERATOR ROOM.

Fluid Insulators.

The insulators illustrated in the cuts are of a peculiar type, and although used in other countries are comparatively unknown in the United States. These devices were designed for the purpose of obtaining the highest insulation by preventing surface leakage. An insulating fluid which, it is stated, will not support a film of dust or moisture, fills a recess, well protected from the weather, in the porcelain body of the insulator. In this way a clean and highly insulating fluid surface is interposed between the line and earth.

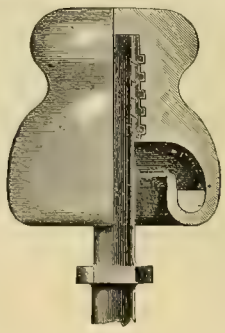


TERMINAL INSULATOR.



INSULATOR FOR CONNECTING AERIAL WITH SUBTERRANEAN WIRES.

These insulators, which are made in numerous patterns of either porcelain or brownware may be employed to advantage on coast lines, where the glass or porcelain quickly becomes coated with a conducting film of salt.



ORDINARY INSULATOR.

The insulation fluid is manufactured by Johnson & Phillips, London, England, under a secret process. The fluid, it is claimed, does not freeze; it does not evaporate; it allows dust to sink to the bottom; it does not creep like paraffine or mineral oils; and it lasts three or four years, even in the East Indian climate. One gallon of the insulation fluid suffices for about 200 of the smaller and 150 of the larger insulators. These insulators are handled by the Electrical Supply company, Chicago.

LEADING IN INSULATOR.

SIPHON.

Electric Lighting Fixtures.

The cuts presented herewith represent a line of specialties recently brought out by E. M. Carhart & Co., Providence, R. I.

Fig. 1 shows a simple form of mast arm, made of double L iron. The L irons are used as conductors, and also as a track to carry the lamp over the street. These tracks with the supporting brace, are insulated from the pole, thus dispensing with the cable, which has always been a source of annoyance, as well as expense. A switch is placed on the pole to cut the lamp out of circuit while being trimmed. Fig. 2 is an enlarged section through the mast arm

Fig. 3 is a tree insulator. This device operates so as to permit the line to remain in a normal position, allowing the tree to sway with the wind, and also to prevent the line from coming in contact with the tree.

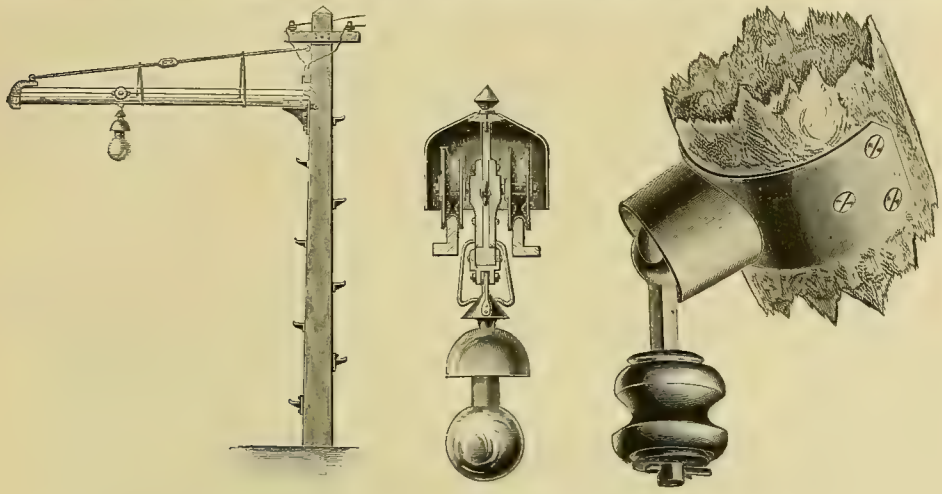


FIG. 1. FIG. 2. FIG. 3.
ELECTRIC LIGHTING FIXTURES.

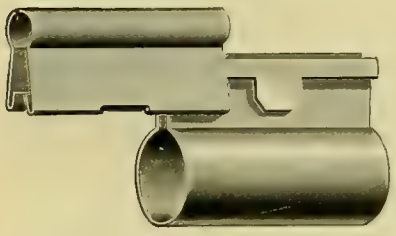


FIG. 7. ELECTRIC LIGHTING FIXTURES.

Fig. 4 shows a carbon holder. The feature of this device is that when the thumb screw is turned to take out the carbon, it keeps open the adjustable part of the holder ready to receive the new carbon. This is accomplished by means of a small collar on the screw inside of the adjustable part which follows out with the screw. This adjustable part is connected to the main body by a pin hinge, no part being separable.

Fig. 5 is a rubber insulator for the bottom of arc lamps. In many cases lamps cannot be hung more than seven or seven and a half feet from the floor or sidewalk, and there have been cases of death caused by persons coming in contact with the bottom of the lamp and the earth circuit. This rubber device is made to fit any style of lamp, and by its use, it is stated, a perfect insulation is secured.

Fig. 6 is a pole step, made removable to facilitate the work of the trimmers. Instead of a trimmer being obliged to carry a ladder in addition to his load of carbons, sockets of the pattern indicated are fastened on the sides of the pole. The trimmer takes two of the small brass steps, placing them in the sockets one after the other, goes up the pole, trims the lamp, comes down, takes out his steps, places them in his pocket, and goes to the next lamp post, and so on.

Fig. 7 represents the Carhart cable clip. This device, as will be seen, is simple in construction, and is easily adjusted in passing a fixture. It is made of the best galvanized iron.

The device described above, with the exception of the cable clip, are inventions of Van A. Thomas, superintendent of the Narragansett Electric Lighting company, Providence, R. I.

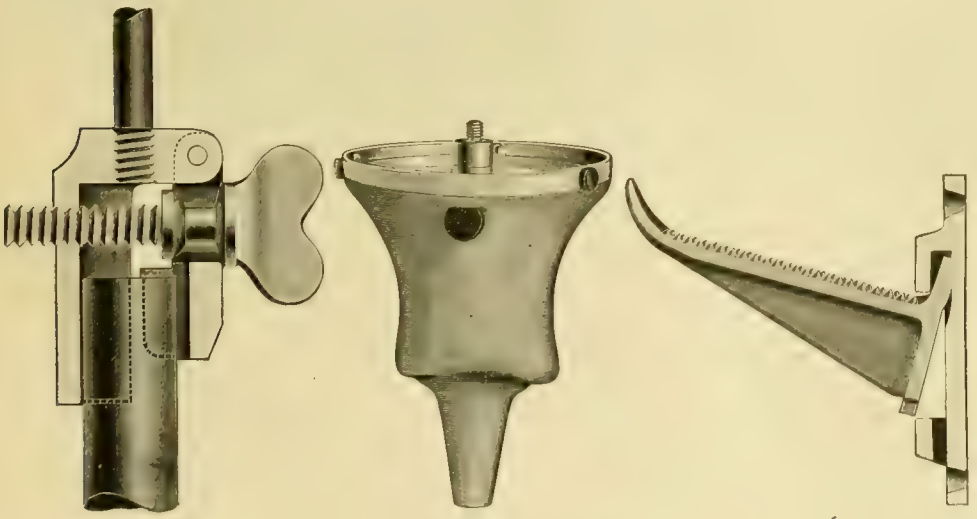


FIG. 4. FIG. 5. FIG. 6.
ELECTRIC LIGHTING FIXTURES.

Extending the Electric Railroad System at Milwaukee.

The contract for rebuilding the Villard lines at Milwaukee into electric roads has been let, and work will begin as soon as the weather permits. Chief Engineer Henderson of the Edison General Electric company and two of his associates visited the Cream City last week and closed the contract with H. C. Payne as the representative of the Villard company. The Edison company and the Villard company are composed of the same gentlemen, so that the Villard people are virtually rebuilding the roads themselves. The amount of the contract is understood to be in the neighborhood of $2,100,000. It calls for the completion of the work within a reasonable time.

Resistance of One Mil-Foot of Copper.

By F. B. Badt.

As the resistance of one mil-foot of copper is the basis of almost every calculation relating to sizes of wires transmitting electrical energy for lighting and power, the writer thought that the following data might be of general interest:

Calculating from Matthiessen's standard, i. e. the resistance of one mile (5280 feet) of chemically pure copper, 1-16 inch (62.5 mils) in diameter, at the temperature of 15.5° C. (59.9° F.) is equal to 13.59 B. A. units, we get:

R of 1 mil-foot of pure copper at 59.9° F.= $\frac{13.59\times(62.5)^2}{5280}$ =10.05415B. A units.

Hence we deduct by the aid of the formula:

$R=r\,(1+at\div bt^2)$ where

R=resistance at the temperature t

r=resistance at 0°C.

t=temperature in degrees C.

a and b constants, assumed for pure copper as follows:

a=.003824.

b=.00000126

R of mil-foot at 0°C. (32°F.)=9.488871 B. A. units.

R of mil-foot at 24°C. (75.2° F.)=10.36661 B. A. units.

A *legal* ohm is equal to the resistance of a column of pure mercury, 1 square millimeter in section, and 106 centimeters long at 0°C.

According to the latest researches the *true* ohm is represented by the resistance of a similar column of mercury 106.3 centimeters long, and one B. A. unit equals .9866 true ohm.[1]

The B. A. unit is therefore represented by a similar column of mercury 106×.9866=104.87558 centimeters long. Hence we deduct:

1 B. A. unit=$\frac{104.87558}{106}$=.9893922 Legal Ohm.

1 B.A. unit=$\frac{104.87558}{106.3}$=.9866 True Ohm.

1 Legal Ohm=$\frac{106}{104.87558}$=1.010721 B. A. Units.

1 Legal Ohm=$\frac{106}{106.3}$=.9971777 True Ohm.

1 True Ohm=$\frac{106}{106.3}$=1.00283 Legal Ohms.

1 True Ohm=$\frac{106.3}{104.87558}$=1.013558 B. A. Units.

On these considerations is based table No. 1.

TABLE NO. 1.

Resistance of 1 mil-foot of soft copper wire:

Temperature.	Conductivity. Per cent.	Resistance in B. A. Units.	Resistance in True Ohms.
0°C. or 32°F.	100	9.488871	9.501719
	98	9.687520	9.552774
15.5°C. or 59.9°F.	100	10.05415	9.919425
	98	10.25933	10.12186
24°C. or 75.2°F.	100	10.36661	10.22769
	98	10.57817	10.43642
32°C. or 89.6°F	100	10.66733	10.52439
	98	10.88503	10.73917

We can find a variety of values for 1 mil-foot of copper in our handbooks. In table No. 2 are given some of the values extensively used in practice:

TABLE II.

Resistance of 1 mil-foot of Pure Soft Drawn Copper Wire in B. A. Units.

AUTHORITY.	0° C. 32° F.	15.5° C. 59.9° F.	24° C. 75.2° F.	REMARKS.
TABLE No. 1.	9.488871	10.05415	10.36661	
H. G. Cheesman, London, Electricians' Directory, 189[illegible] (page 159).	..	10.25415	.....	
Munroe & Jamieson's Pocket Book, 18[illegible] (page 195).	9.718	.....	.....	
Walter T. Glover & Co., Wire Table in E. W. C.	.....	10.32311	.....	
John T. Sprague, "Electricity," page 195.	.....	10.3365	.....	
Carl Hering, in New York "Electrician," Dec., 1885.	.....	10.10721	.....	*Hering gives the resistance as 10 legal ohms=10×1.010721=10.10721 B. A. Units.
Sidney B. Paine, B. & S. Gauge Wire Table	.....	.....	1.792813	
Geo. B. Prescott, Jr., (B. & S. Gauge Wire Table.)	.....	.....	10.381	

1 See report of the committee on electrical standards, read before the British association, Leeds, September, 1890.

The wire tables generally used in the United States by practical men for electric lighting and power purposes are that of Prescott for the B. & S. gauge and Glover's for the B. W. gauge. Prescott's value of one mil-foot coincides within a very small fraction with our own; Cheesman's is the same as ours, the others deviate considerably. Remarkable is the fact that although the *Legal Ohm* was determined in 1884 the wire tables which we are using in practice to-day still give the resistance in B. A. units.

Most of our voltmeters are nowadays standardized in *legal* volts and resistance coils in *legal* ohms, and certainly our wire tables should give the resistance in *legal* ohms or still more preferable in *true* ohms and not in obsolete B. A. units.

A few other points may be mentioned in this connection. Resistances in our wire tables for *practical* use should be given for commercial and not for pure copper. Of course, any one using, for instance, the Glover wire table is supposed first to change B. A. units into true ohms, then allow for, say 98 per cent. conductivity, and lastly, if the temperature of 60°F. should be too low to make allowance for a higher temperature.

These operations take considerable time, and we venture to state that not one out of a thousand in the daily rush of business will go through even one of these operations As a consequence these values are simply used as they are found in the wire tables whether they are correct under the circumstances or not.

A wire table for practical, everyday use in offices of electric light and power companies, in the opinion of the writer, should give the resistances of the wires under the following conditions:

First. The unit of resistance should be the *true ohm*. Second, the resistances should be calculated on the basis of *commercial* and not of *pure* copper wire. As most of our manufacturers guarantee 98 per cent. conductivity this should be the standard. Third, the standard temperature should be the mean temperature plus the rise of temperature caused by the electrical current.

In explanation of point three, this statement is made: A standard temperature of 60°F. or 75°F, may do for telegraph, telephone and kindred wires, and even for arc light wires carrying a comparatively feeble current, which does not heat the conductor perceptibly above the temperature of the air.

If we assume the mean annual temperature of our dwellings, offices and public buildings to be 24°C. (75°F.) the estimate may appear to be high to our English friends, who have never lived in our tropical climate in summer or in our overheated houses in winter, but we consider it a very conservative figure. If we now assume that the mean current will cause an increase in the temperature of the wires of 8°C. (14.4°F.) we make a very conservative estimate again. The standard temperature would then be 32°C. (89.6°F.) We know of many installations in which wires are heated considerably above 100°F. Most tables of "safe" carrying capacity, in use to day, allow for an increase of from 18°F. to 80°F. above the temperature of the air.

With outside wires carrying heavy currents for incandescent lighting and power installations the case is a little different. The mean temperature for the United States during a whole year is only 53.28°F. For overhead wires however, generally a much greater increase of temperature is allowed than for wires inside of houses. Assuming the standard temperature for inside wire to be 32°C. (89.6°F) we would allow for an increase of temperature of 20.18°C. (36.32°F.) for inside wires.

We therefore suggest that wire tables for electric light and power installations be calculated on the basis of a temperature not below 32°C (89.6°F)

The Rae Generator and the Detroit Electrical Works.

The improved type of Rae electric railway generator is represented in Fig. 1. The Detroit Electrical Works build these generators in sizes of 40,000, 65,000 and 80,000 watts. The e. m. f. of 550 volts is maintained throughout the Rae system. The generators are all compound wound. The field magnets are made with wrought iron cores, and the cast iron yoke pieces are designed of a section equivalent in magnetic capacity to that of the wrought iron. The compound winding consists of a flat ribbon of copper, which is made equal in section to that of the armature conductors. These series coils, it will be noticed, are placed at the ends of the magnet cores, and against the cast iron yokes.

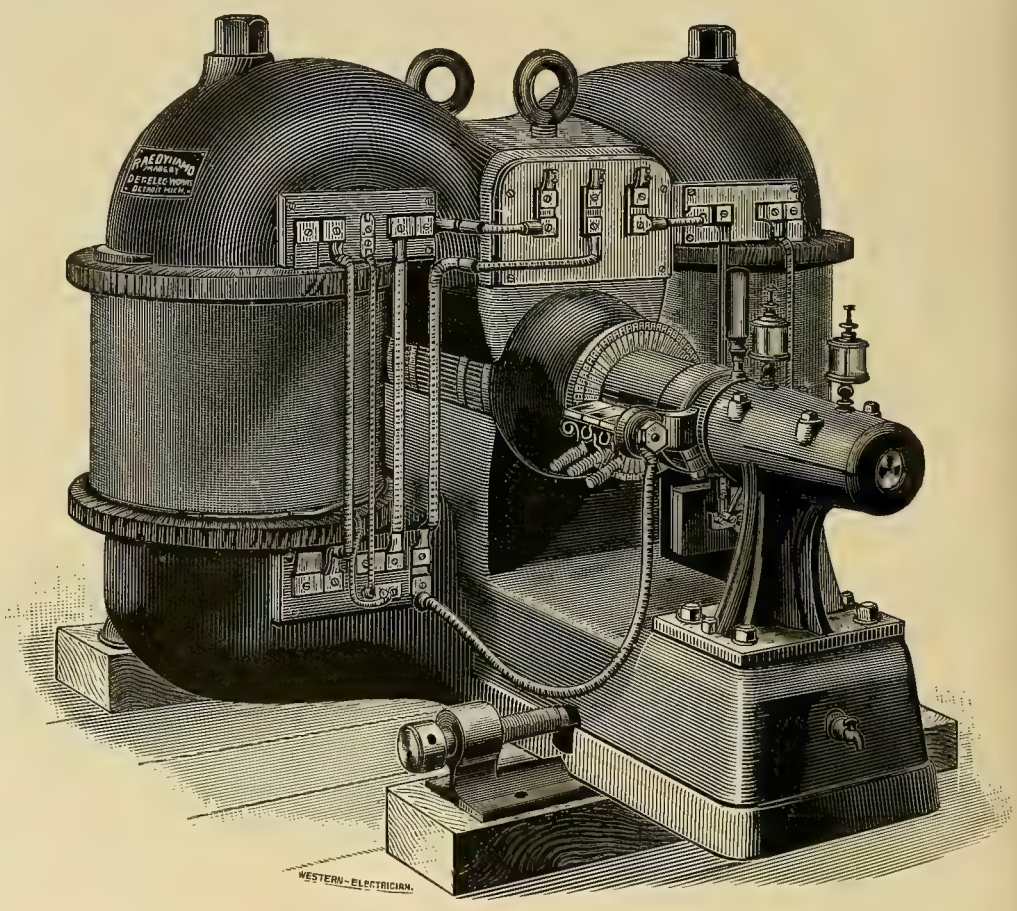
The Siemens armature is built up of soft iron disks .007 inch in diameter, covered with shellacked tissue paper. At every 20 disks a layer of shellacked cloth is interposed in order to thoroughly provide against the generation of Foucault currents. The core is mounted on four brass splines, let into the shaft, and so arranged that an air space is left between the shaft and the inner edges of the disks. The commutators of all the machines have 80 sections, and the following are the electrical dimensions of the 65,000-watt machine: Armature wire 1,000 feet of No. 4 B. & S., resistance, .061 ohm; shunt winding, No. 17 B. & S., resistance, 250 ohms. The series coil has a carrying capacity equivalent to that of the armature, and consists of 60 turns complete, 15 in each coil.

In Fig. 2 is given a view of one of the shops in the Detroit Electrical Works.

The Deterioration of Incandescent Lamps.[1]

It is usual to consider that the 16 candle power incandescent lamp requires 50 watts of electric energy to raise it to its normal brilliancy. This, no doubt, is a fairly accurate estimate, as applied to a new lamp, but unfortunately it is not one that remains true during the whole life of the filament. The slender rod of carbon commences to alter its constitution under the intense heat to which it is raised, and its atomic condition undergoes a change. The effect of this change is to be found in two directions; the resistance of the filament increases, so that less current passes through it under uniform conditions of electromotive force, while at the same time the light-giving efficiency of the filament is reduced. The result is a notable falling off in illumination. The lamp takes rather less current; and, therefore, gives very much less light. Even the illumination that is produced is much impaired by the blackening of the globe. The purchaser of such a lamp has much the same experience as one who buys a gas burner. This latter appliance gives a certain lighting power under certain conditions of pressure, and so long as the edges of the orifice remain clear and smooth. But in most buildings the pressure of gas varies considerably during the evening, while it takes but a short time for physical deterioration to commence in most of the ordinary patterns of burners, and to reduce their efficiency by 20 or 50 per cent.

Some years ago there was published a full account of the life histories of certain lamps tested by the Franklin Institute, and these all revealed a steady deterioration in their efficiencies. An interval of five years has converted these tests into ancient history, but it has not enabled the manufacturer to overcome all the difficulties then demonstrated for the first time. The user has still to reconcile himself to the fact that an old lamp is a more extravagant appliance than a new one, and that all lamps age with great rapidity in the early part of their career. The question has been taken up by several observers in America. In 1887 Messrs. Whitmore and Pearson in the Massachusetts Institute of Technology, made "A Study of the Efficiency of Incandescent Lamps," which was afterward modified and published by W. L. Puffer. This, however, dealt more with the relative efficiencies of different makes of lamps, than with the varying efficiencies of the same lamp Later W. H Pierce read a paper before the American Institute of Electrical Engineers on "The Relation between the Initial and Average Efficiency of Incandescent Electric Lamps," in which the subject was very fully discussed. The tests embraced ninety-four lamps, representing four of the most prominent makers. Fifty-nine of these were bought in the usual way, and thirty-five were sent direct from the makers, and were probably selected with care, although as the names were not published, the results of the tests could not affect the makers commercially. Special care was taken to obtain reliable apparatus for the tests, and it was verified from time to time while they were proceeding. The candle-power of a lamp was assumed to be the mean of twelve points 30 deg. apart in the horizontal plane of the lamp, and the volts at which it was run were taken from those marked on the lamp by the makers. The candle powers in the efficiency measurements were taken after the following intervals: 55, 110, 200, 300, 400, 500, 600, and 820 hours. The average results were tabulated from groups of 10 to 15 lamps. The average watts per candle power for the different makes of lamps varied from 4.58 to 5.80, a very considerable contrast to the 3 watts usually assumed. The average percentage of the initial candle-power over the whole test varied from 57 to 98 per cent. This last figure is remarkable, but the reason of it will appear later, as it affords a demonstration of what seems to be a curious law in regard to carbon filaments. When we separate the lamps into groups, according to their initial efficiency, the same law is again shown. Those lamps which had an initial economy of less than 3.2 watts per candle-power gave an average percentage of initial candle-power varying from 51 to 64, while the average watts consumed during 900 hours varied from 4.54 to 5.84. Out of eleven lamps in this group four fell to an efficiency of 6 9 watts, while the remainder fell to about 5½ watts, at which point the curve became nearly flat. Lamps with an initial economy varying from 3.2 to 3 5 watts per candle-power gave an average varying from 4.94 to 5 61 watts, while their percentage of initial candle-power during the run varied from 60 to 66. There were eighteen lamps in this group five of one make and thirteen of another. The first required 6¾ watts at the close, and the latter 5 watts. Nine lamps required from 3.5 to 3.8 watts to commence with, and from 5 to 7 watts at the close of the test. The average watts varied from 4.61 to 5 59, and the average percentage of initial candle-power from 66 to 82. There were eleven lamps starting between 3.8 and 4.1 watts, and ending between 5 and 7 watts. The average watts over the test varied from 5.54 to 6.07, and the percentage from 67 to 88. Between 4.1 and 4.4 watts there were fourteen lamps, all ending between 5 and 6 watts, and having an average of 4.79 to 5.39 watts, with percentage of initial candle-power varying from 84 to 90. There were 13 lamps starting between 4.4 and 4.7 watts, and ending between 5 and 6 watts. The average watts were 4.75 and 5.6 for the two groups of five each, and the average percentage 82 and 98. One group of lamps improved in efficiency for a short time, falling from 4 4 to 4 2 watts in the first hundred hours. Five lamps started between 4.7 and 5 watts; they first fell to 4.2 watts in 100 hours, and then steadily rose to 5.5 watts in 900 hours the average being 4 97, and the average percentage of candle-power 101 per cent. After 100 hours the lamps gave 118 per cent. of the initial candle-



RAE GENERATOR.

[1] Abstract of a paper in London Engineering, Jan. 23.

[2] Mean annual temperature at 131 stations of the Signal Service U. S. Army for twelve years, 1873 1884, is 53.28°F. Compare annual report of the Chief Signal Officer, Washington, D. C. The mean annual temperature of Chicago is 49.09°F.

power. The above facts are shown in the annexed table:

TABLE SHOWING AVERAGE WATTS USED PER CANDLE POWER.

Number of Lamps.	Mark.	Initial Watts.	Watts After 900 Hours.	Average Watts.	Average Per Cent. of Initial Candle Power.
4	B	3.2	5.5	4.54	64
3	A		5.5	4.92	59
4	C		6.9	5.84	51
13	A	3.2 to 3.5	5.8	4.94	66
5	C		6.7	5.61	60
1	B		5.1	4.61	83
6	A	3.5 to 3.8	6.0	5.09	71
2	C		7.0	5.59	66
2	D		5.5	4.57	88
4	B	3.8 to 4.1	5.0	4.54	86
2	A		6.1	5.25	73
3	C		7.0	6.07	67
5	B	4.1 to 4.4	5.0	4.81	87
5	D		5.1	4.79	90
4	C		6.1	5.39	84
8	D	4.4 to 4.7	5.1	4.75	93
5	C		6.1	5.60	82
5	D	4.7 to 5.0	5.5	4.97	101

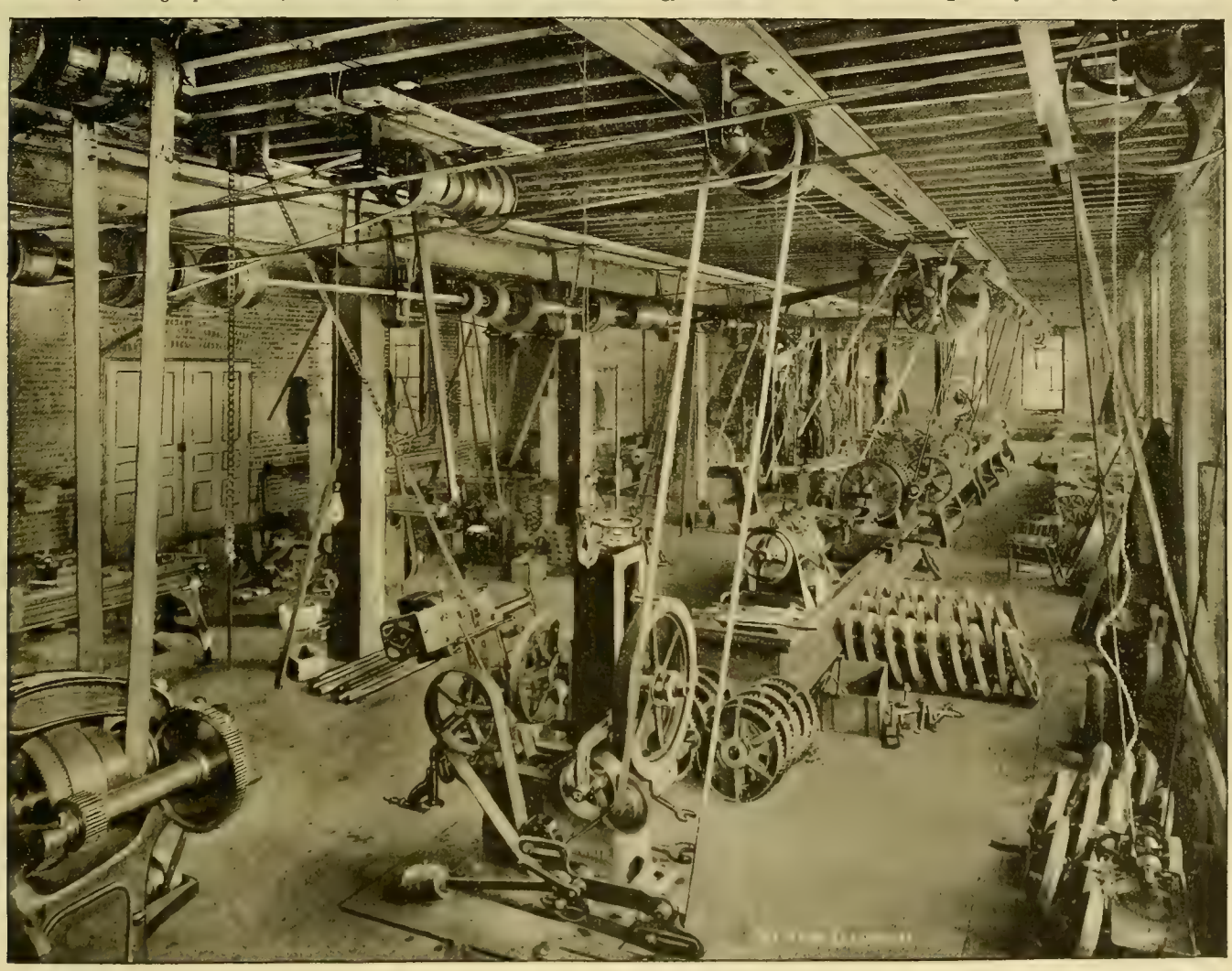
An inspection of the table shows that the C group were the least economical, and the B group the most so, but the difference was not great. It also shows that a lamp which starts with a high efficiency is not necessarily more or less efficient than one starting with a low efficiency. For instance, if the C series be traced it will be seen that the average watts run in the following order: 5.84, 5.61, 5.59, 6.07, 6.39, 5.6, that is they all lie on a curve (except the 6.07) that falls steadily until it begins to rise near the end. The lamps that begin with a high efficiency give a lower average efficiency than those that begin with a low efficiency. In the D series this is reversed, the averages being 4.57, 4.79, 4.75, and 4.97, that is, the lamp that begins, with the lowest watts maintains its superiority over those that start above it. In the A and B series there is first a slight increase in efficiency, and then a rapid decline. As might be anticipated, the lamps that began with a low efficiency did not fall off so much during the course of the trial as those which commenced more brilliantly, indeed some of them actually improved for a time.

It must be remembered that these lamps were all made in America, where competition is very keen, and that they cannot be taken as exact guides to the behavior of lamps made in England, which are sold at a higher price, and may possibly have more care expended over them. Still as the filaments, wherever made, are of the same material, it is fair to assume that the general law of progressive depreciation which we see in the tests before us, will hold universally. The carbon filament appears to be in an unstable molecular condition in a new lamp, and to suffer a rapid change under the influence of its incandescence. However few may be the watts required per candle-power in the first instance, they rapidly increase to between five and six, after which further change is very slow. Recently Professor Edward L. Nicholls has treated of the matter before the New York Electric club. He ran a 16-candle power lamp for 800 hours, commencing with an expenditure of 3.015 watts per candle, and increasing fairly steadily up to 5.75 watts. In the same time the resistance of the filament rose from 216 ohms to 278 ohms, and the light fell from 16 candles to 6½ candles. Of course a trial with one lamp is not of very great value taken by itself, but in this case it fully confirms the figures we have already given.

A more interesting experiment consisted in increasing the electromotive force at short intervals, so as to keep the candle-power at the normal figure. Under this treatment the lamp failed in 100 hours, which is much sooner than we should have anticipated. The total rise in electromotive force during the test amounted to 9 volts; the efficiency decreased from 3.118 watts per candle to 3.468 watts, and the resistance of the filament rose from 221.6 ohms to 234.8 ohms. During the first fifty hours the changes were slight, then occurred a sudden increase of resistance with a marked rise in the amount of energy consumed.

As incandescent lamps become cheaper it will be apparently more economical to run them at a higher temperature, thus gaining an increase of efficiency at the expense of shortening their lives. Now supposing that lamps could be bought for one or two shillings each it is quite evident that it would pay to burn down several in the course of the year, if a higher efficiency could be gained at the expense of an abbreviated existence. A short life and a brilliant one would then be the motto to be inscribed on a glow lamp. But from the experiments we have quoted there seems to be good reason for consumers to receive with caution the assurance of manufacturers regarding the efficiency of their lamps. We do not mean that these will not be strictly accurate as regards the lamps in their new state, but there seems reason to believe that after a hundred hours or so a totally different state of affairs will have set in, and that both high and low efficiency lamps will then have both fallen to the same level of performance, with this difference, that the one which started with the greatest brilliancy will have suffered from the effect of the high temperature to which it has been subjected. In addition the general illumination of the apartment will have fallen very considerably, while the eyes of the occupants will have become educated to demand a high standard of illumination, and will naturally feel the change.

A glow lamp which gives a candle power for less than three watts is generally too brilliant to be looked at directly, and unless very carefully situated, so that there is little chance of the gaze straying accidentally on to it, must be screened in some way. If its full light be taken into the eye it paralyzes the part of the retina on which it falls for a short time, and renders it less sensitive to the reflected light thrown from books and objects. The owner finds himself on the horns of a dilemma; he must either waste some of the light by means of partly opaque screens, or his eyes will refuse to avail themselves to the full extent of the illumination provided for them. This, however, is a trouble that tends to rectify itself very rapidly. The experiments show the American lamps all fell rapidly to a point where they required at least five watts per candle-power, and probably this is law for all carbon filaments. The intense vibration of the atoms caused by a higher temperature than that corresponding to this efficiency, rapidly alters the structure of the conductor, and exercises a defensive action by increasing its resistance to the passage of the current. The ardently desired one watt lamp, which is to banish gas from the field of illuminants, will certainly not have a carbon filament. Of what it will be composed, assumed that it should ever come into existence, there is yet no possibility of saying. For the present we must be content with what we have, and when we complain, as we often do, that the same nominal light does not go so far in electricity as it does in gas, we must remember that glow lamps hasten to put themselves on the safe platform of 5 watts to the candle-power quite regardless of whether they started from 4, or 3, or even 2½ watts.



DETROIT ELECTRICAL WORKS—VIEW IN ONE OF THE MACHINE SHOPS.

Minneapolis Electric Railway and the Snow Storm.

A Minneapolis correspondent writes as follows: "Sunday, February 8, we had the heaviest snow storm of the season. The electric railway ran with practically no delay, seventy-two motors and four snow plows, the snow plows running all night. The meter registered nearly 2,000 amperes, rather overtaxing the single Corliss engine of 1,260-horse power, but the company pulled through in fine shape."

The Florida Electric company, of Tampa, Fla., has been formed; capital stock, $100,000; J. Rush Ritter, president; C. H. Emerman, secretary; W. A. Green, superintendent and electrician. The plant consists of four Westinghouse alternating dynamos, capacity ninety arcs and 1,000 incandescents; five Westinghouse engines, 5 Erie boilers, Munson belts, Standard wire, and 35 miles of street circuits.

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J. B. O'HARA, - - - - - - - - - - }
F. L. PERRY, - - - - - - - - - - }
A. C. DURBOROW, JR., - - - - - - Business Manager.

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THE next issue of the WESTERN ELECTRICIAN will contain a stenographic report of the National Electric Light convention to be held at Providence February 17, 18 and 19.

THE Cushman telephone case, involving Dr. Cushman's claim to the priority of invention is to be reviewed. A Chicagoan, charged with infringing the Bell patents, puts in the defense that Dr. Cushman is the real inventor of the telephone. If the attorneys are to be believed an extended period of interesting litigation may be expected. The case is referred to elsewhere in this issue.

IT is probable that the National Electric Light association will receive an invitation urging it to hold its next convention in Montreal. In the last number of the WESTERN ELECTRICIAN the fact was mentioned that a Montreal gentleman was particularly anxious that the association should meet in his city next summer. He asserts that substantial advantages to electrical industries would be gained if the association should meet on Canadian soil. He says that the members would be given a most cordial reception, and that their stay would be made highly enjoyable.

THIS issue of the WESTERN ELECTRICIAN is published several days in advance of the date it bears, in order that copies may reach those who are in attendance at the convention of the National Electric Light association at Providence February 17, 18 and 19. The contents of the number will be of marked interest, we think, to those present, as a considerable part of the matter was prepared especially for this convention issue. It will be noticed that several electric plants in Providence which the members of the association will doubtless inspect, are illustrated and described.

IN this issue Prof. F. B. Badt furnishes some interesting data relating to the resistance of one mil-foot of copper. Prof. Badt points out that we can find in hand-books a great variety of values for one mil-foot of copper and also that although the legal ohm was determined in 1884 wire tables of today still give resistances in B.A. units. After calling attention to numerous inconsistencies, the writer gives his opinion as to the manner in which a practical wire table should be made out. The article is concluded with the suggestion that wire tables for electric light and power installations be calculated on the basis of a temperature not below 89.6° F.

THE second electric street railway installed in Chicago is illustrated elsewhere in this issue. It is practically an extension of the Madison street cable line, and passes through one of the most delightful suburban districts on the West Side. The excellent service which the new road will furnish will greatly enhance the value of the property in this section. Thus far, the electric railway service in the suburban districts of Chicago has proved a boon to property owners, and at present there are several projects on foot to secure the introduction of the electric system in other quarters. It is interesting to note that the cable system was not extended in the present case, but an electric road put in to the satisfaction of patrons of the line.

RECENT numbers of the WESTERN ELECTRICIAN have contained a great deal of matter relating to the World's Fair. In the last issue was published the report of the World's Fair committee of the Chicago Electric club which gave a comprehensive plan for the organization of the electric department. The suggestions of the committee have aroused no little interest as the general outlines of the plan, at least, will, in all probability, be adopted by the authorities. It is not unlikely that the World's Fair will come up for consideration at the convention of the National Electric Light association at Providence. In that event this report which was published exclusively in the WESTERN ELECTRICIAN, will be of great value for reference. A supply of this issue will be found in the headquarters of the WESTERN ELECTRICIAN, Narragansett Hotel.

THE Board of Public Works of Kansas City, Mo., deserves special commendation for the position it assumed on the subject of burying electric wires. A bill is pending before the Missouri legislature providing for the burying of all electric wires within a specified time; otherwise, the local Board of Public Works is authorized to do the work. The Board of Public Works of Kansas City passed resolutions expressing its disapproval of the provisions of the bill, and the president of the board explained the position of the other members by saying that they were contented to await the solution of the problem by electrical engineers. The gentleman asks what special qualifications the officials have for disposing of a question which has proved a bone of contention for the best electrical engineers of to-day. It is certainly a hopeful sign of advancement to find a city official who recognizes that the construction of electrical subways involves engineering problems, and is a greater undertaking than the digging of a ditch. There is no doubt that all the vexed problems involved in the construction of conduits will be solved eventually, but the enactment of measures like that proposed by the Missouri legislature will only serve to embarrass those seeking permanent relief.

PERHAPS the majority of the readers of the WESTERN ELECTRICIAN are not interested in nautical instruments, but there are many who can appreciate any well-adapted application of electricity in whatsoever line it may be. In reading the description of a new electrical log, presented in this issue, one is struck with the ingenuity displayed by the inventor in devising his log system so that the ordinary primary battery as a source of current, is dispensed with. In this apparatus the iron hull of the ship is made to form one pole of the battery and a thick zinc tube in the log proper, the other pole, and the sea water the exciting fluid. In this manner it will be readily seen that almost the entire rigging of the log is made to form a zinc-iron couple in salt water. For this arrangement the inventor claims certain important advantages. The description is worth a careful perusal.

IN another column there is presented an article from an English contemporary on the deterioration of incandescent lamps. The paper treats of a subject already quite familiar to American experts through the efforts of W. H. Pierce, Prof. Nicholls and others. From a scientific standpoint the portion of our contemporary's discussion relating to W. H. Pierce's paper on the "Relation Between the Initial and Average Efficiency of Incandescent Electric Lamps" is interesting. In this connection, however, we cannot forbear to express a wish that some unbiased and unprejudiced experimenter would take upon himself the thankless task of publishing a paper in which correct tests would be chronicled without withholding the names of the manufacturers. We have no desire to belittle strictly scientific investigations. On the contrary it is our aim to encourage all efforts in this direction. But we fear it must be a fact patent to the most careful of readers of the electrial journals, that there are few contributors who ever come to the front and fearlessly give strictly accurate figures appertaining to any one make of apparatus. To illustrate our point: Those who read Mr. Pierce's paper no doubt fully realized its worth from a scientific standpoint, but how much more valuable would this production have been had the writer been in a position to give the names of the manufacurers whose lamps he so thoroughly tested.

THE necessity of improving the construction work on telephone and telegraph lines has been repeatedly shown of late, the great storms in the East playing havoc with both systems. In the recent storm in Albany telephone and telegraph wires were broken down, crossing electric light wires and burning out switch-boards and subscribers' instruments throughout the city. There was only one telegraph wire between New York and Albany in operation after the storm began and the telephone system was entirely wrecked. Owing to the danger from fire, the dispatches say, the manager of the telephone company requested the mayor to order the electric light and street railway power houses shut down, thus leaving the city in darkness and without means of transportation in a blinding storm. It is probable that the telephone lines of Albany when reconstructed will be much more substantially built than before the storm. The company's loss will be enormous. The switch-board, recently completed at an expense of $15,000, was destroyed. It should be noted in this connection that the telephone companies have been investing considerable money in construction work during the last two years and the standard is far superior to that of earlier days. The improvements should be continued until such experiences as that at Albany last week will be impossible. It is in the interest of the companies that this matter be considered at once.

Paris Central Market Alternating Current Plant.

The alternating current plant of the Central Market electric light station in Paris has been in operation since December 15. Ferranti alternators each of a capacity of 2,400 volts and 45 amperes are operated. The machines which make 520 revolutions per minute are driven by three Leconteux & Garnier engines, each of 170-horse power. Thury dynamos are used as exciters. They are mounted on the armature shafts of the alternators.

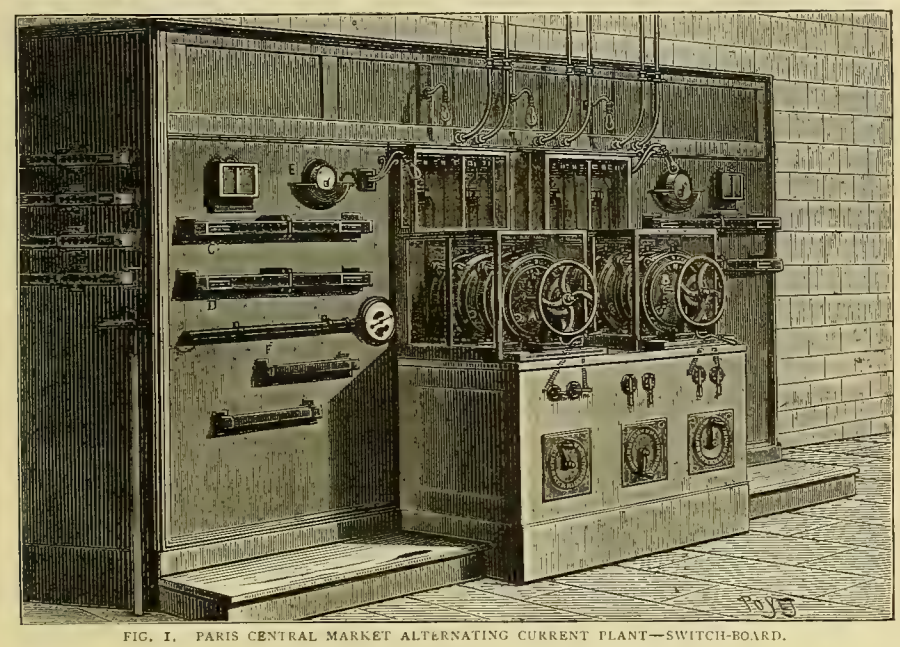


FIG. 1. PARIS CENTRAL MARKET ALTERNATING CURRENT PLANT—SWITCH-BOARD.

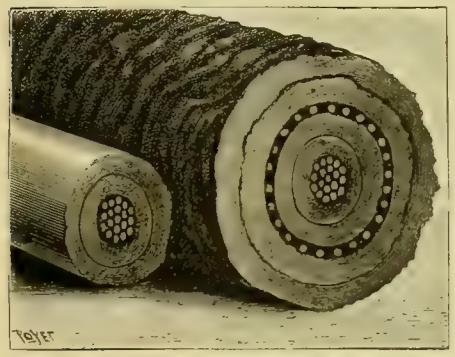


FIG. 2. PARIS CENTRAL MARKET ALTERNATING CURRENT PLANT—CABLE USED IN THE UNDERGROUND SYSTEM

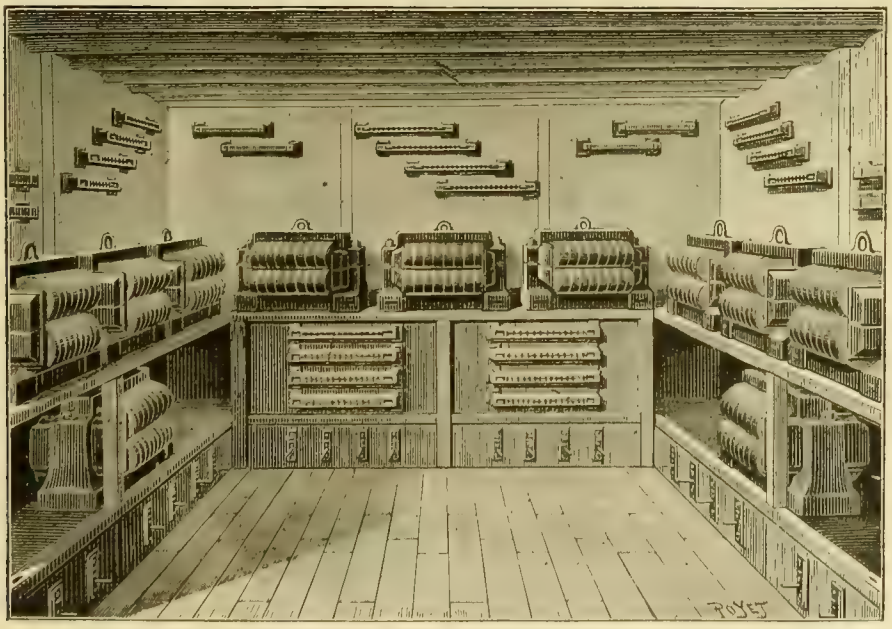


FIG. 3. PARIS CENTRAL MARKET ALTERNATING CURRENT PLANT—TRANSFORMER ROOM.

In Fig. 1 is shown the switch-board in the station. The main switches are shown at *A* and *B*; *E* is the ammeter; *F* the voltmeter.

A part of the cable which is used in the distribution of current is of the kind shown in the sectional view Fig. 2. It is made as follows: A copper wire, 60 square millimeters in section is covered with pure rubber, one millimeter in thickness; over it is a covering of vulcanized rubber eight millimeters in thickness; this part of the cable is wound with two thicknesses of insulating tape; over these are the wires forming the other conductor; then are applied pure rubber, vulcanized rubber, tape, hemp saturated in a resinous mixture, and finally an outside cotton covering. Only a comparative small quantity of this concentric cable is used. The rest of the cables are of the ordinary type, but highly insulated. All the conductors are located underground. The principal store which takes current from the station is La Belle Jardiniere.

Fig. 3 gives a view of the transformer room in the establishment. There are eleven transformers in the apartment. The wires throughout the building are concealed under mouldings.

There are used in the building 1,265 16-candle power incandescent lamps and 100 arc lamps. The latter are the Pieper alternating current lamps which take 60 volts and seven amperes. The cuts are reproduced from *La Nature*.

Electric Motors for Lift Bridges.

The executive board of the city of Rochester, N. Y., has been considering the advisability of employing electric motors for lifting the bridges that cross the Erie canal in that city. It is proposed to provide power for fifteen bridges, and it has been assumed that at least four of them will at times be lifted simultaneously, and that a period of fifteen seconds will be occupied for each lift; furthermore, that each bridge will be lifted at least eight times per hour during a period of ten consecutive hours of the day of greatest canal traffic, when 112 lifts of each bridge were made.

These data were submitted to the Thomson-Houston Electric company of Boston, Mass., and that company estimated the cost of fitting the bridges for electrical power at $34,000, exclusive of a power station, and $5,000 per year for operating expenses. The matter is favorably considered by the city authorities, and will undoubtedly be given careful investigation.

New Trolley Wire Clamp.

One of the principal features in the installation of electric roads is the proper construction of the appliances for connecting the trolley wire to the span wire. Objections have been made to the ordinary means of holding the trolley wire, because it has been necessary in many cases either to solder the connections which necessarily weakens the wire, or to hammer together the sides of the clamp, which may cause trouble and delay in adjusting the position of the insulator. To obviate these and other disadvantages, the Electric Merchandise company, Chicago, have just placed on the market the Brewster clamp shown in the cuts. Figures 1 and 2 show the clamp which is made of two sections of hard brass riveted together with a steel pin. After the clamp has been placed upon the trolley wire and closed, the insulator is screwed down upon it, firmly holding the wire without soldering or hammering, and presenting a perfectly smooth surface to the trolley. Figures 3 and 4 show a clamp attached to the standard trolley wire insulator. The clamp, however, can be used on any trolley hanger.

FIG. 1.

FIG. 2.

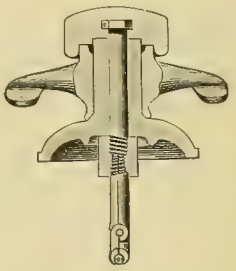


FIG. 4.

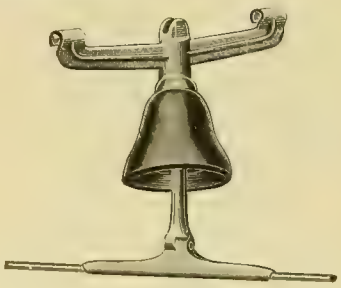


FIG. 3.

TROLLEY WIRE CLAMP.

Seiseophone.

In the WESTERN ELECTRICIAN of June 7 last, was described the seiseophone, the object of which is to discover hidden defects, such as air holes, flaws in welding, etc., in metals. The instrument has recently been exhibited in London by the inventor, Capt. Louis de Place. The instrument consists of a microphone which is connected by wires to a small hammer worked pneumatically by pressure on an India-rubber ball similar to those used for working the sliding shutters of a photographic apparatus. In testing a piece of metal its surface is explored by blows given by the pneumatic hammer, and the sound is conveyed to the microphone. It is necessary that the person using the microphone should be at such a distance from the person using the exploring hammer that the former cannot hear the actual blows of the hammer. This result was obtained by placing the two investigators in different rooms. Captain de Place himself held the microphone to his ear, while an assistant used the pneumatic hammer in an adjoining room. Specimens of cast iron, wrought iron and steel had been brought, and some bars of wrought iron had been specially prepared with defective welds by Mr. Sterling. Captain de Place successfully localized these faults, and the bars were afterward cut in order to examine the fracture. The experiments were successful with the wrought iron welded bar, but not so good with those of cast iron. The inventor, however, states that with bars

of such small dimensions, as about 18 inches long by 1 inch square, it is difficult to obtain good results. He claims to be able to detect flaws in masses of metal, even at a depth of 10 inches below the surface, and states that the apparatus is so simple that after a little practice a workman can use it. He was, it is stated, laboring under a disadvantage at the London exhibition from the noise caused by the talking of the visitors with one another in the room, and he states that silence is essential to obtain good results. Signals were given by means of an electric bell between the two rooms, and the piece under investigation was marked when the signal was given that a flaw was observed.

A New Electric Log.

A new form of electric log has recently been introduced to the shipping world.

An apparatus used for measuring the speed of a vessel, a small "fan" or "propeller" is generally drawn through the water eitherastern or abeam of the ship, and is, in consequence, caused to rotate with a speed which is intended to be proportional to that of the vessel.

There are two types of mechanical logs based upon this principle. In the first the rotating fan is directly geared to a clockwork train which counts the revolutions and indicates in knots, on a series of two or three dials, the total distance run, the whole apparatus being towed through the water at the end of 30 or 40

FIG. 1. NEW ELECTRIC LOG.

fathoms of line. With this arrangement, whenever it is desired to ascertain the distance run, the whole length of line must be hauled in, and this is no easy task with a rapidly steaming vessel, the strain being very great. Another disadvantage is that while an observation is being made the log is idle, and the distance run is unrecorded. Again, it occasionally happens, that, while being towed, seaweed or floating refuse fouls the log, rendering the indications useless, and this cannot be ascertained until the log is hauled on board. In the second form of log the fan alone is drawn through the water, being rigidly attached to a long length of line as before. The fan in this case rotates the whole line, the ship end of which is connected to the counting apparatus fixed upon the stern rail of the vessel. This device requires a table of corrections, for in consequence of the excessive amount of work required to be done by the "fan" in rotating so long a length of line, a portion of which is continually in the water, the speed of rotation is not nearly proportional to that of the ship; in fact, at a slow speed it may be 20 or 25 per cent. too low, therefore, to be exact, it is first necessary to

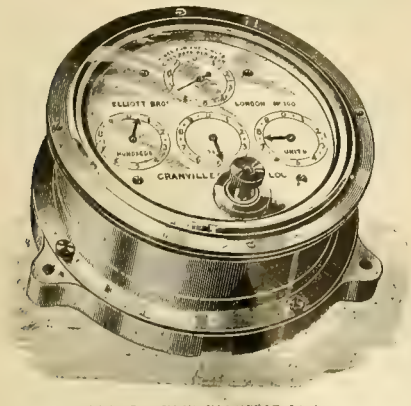


FIG. 2. NEW ELECTRIC LOG.

know the speed of the ship before the right correction can be applied.

The very obvious advantage of combining the accuracy of the first type with much more than the convenience of the latter, has induced several to attempt to construct an electrical log by causing the rotating fan to periodically make and break contact and thereby, by means of a conducting tow line and a battery cell, work an electro-magnetic counter placed in any position on board ship. This idea, so captivating and simple in theory, has repeatedly been tried and apparently proved to be impossible in practice, and that for the following reasons: In the first place the tow line, which is alternately wet and dry, is subjected to a great amount of rough handling, and is kept in a continuous state of movement, due to the action of the waves and the motion of the ship, so that in a very short time the insulation becomes faulty.

Secondly, the attachment between the end of the log line and the log must be perfectly water-tight and insulated, and, lastly, there must be a contact chamber kept perfectly free

FIG 3. NEW ELECTRIC LOG.

from moisture, although so arranged that the contact maker inclosed in it is worked by the movement of the fan, for any loss of insulation in the whole system would short-circuit the battery through the indicator, and so lead to failure.

That this necessity of having perfect insulation has so often proved fatal can be clearly understood, when we consider that with modern ships the log is often towed at a speed of 20 knots per hour, with the result that the salt water is forced through apparently the most perfect joints.

Again, a ship may have to stop before a log can be hauled in, and consequently the log sinks to the full length of its line—say, 30 fathoms—which means a pressure of 80 lbs. upon the square inch—enough to ruin any so-called water-tight chamber.

W. P. Granville, of England, while accepting the principle of the rotating fan, has devised an electrical method of recording the number of revolutions, and by his device it is claimed insulation is rendered unnecessary.

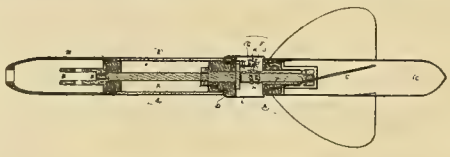


FIG. 4. NEW ELECTRIC LOG.

By this system a battery cell is dispensed with, for the hull of the ship forms one pole of a battery, a thick tube of zinc in the log itself the other pole, and the sea water the exciting fluid; thus there is formed a zinc-iron couple in salt water having an approximate electromotive force of .7 volts, and an internal resistance of about 1 ohm. It might appear, at first sight, that the wide separation of the two component parts of the battery would cause a large increase in the internal resistance; but this is not so, for experiment proves that after the first few inches, the distance between the two electrodes is practically immaterial, so far as the resistance of the salt water is concerned.

This method possesses many advantages; for instance, the current is perfectly uniform, not only on account of the infinite quantity of the exciting fluid, and the dimensions of the iron electrode, but chiefly because the elements being kept in rapid motion, no polarization can occur. The most important benefit gained is, however, that it enables insulation from the sea water to be dispensed with (in an actual experiment the log, it is stated, was towed with 100 feet of bare pianoforte wire and the indicator worked perfectly). To understand this we have only to consider that, under these conditions, the effect of using an uninsulated tow-line is simply to provide a shunt circuit direct to the sea. If the battery or conductor had high resistance this would be fatal, but, it is well-known, that with a battery of low internal resistance the current in a wire connecting the two terminals is but little affected by the addition of a second wire or shunt circuit, the reason being that the second circuit, although absorbing current diminishes the total resistance; and, therefore, increases proportionally the total output, so that the current flowing through the original wire remains almost unaltered.

The log and indicator are shown in perspective in Figs 2 and 3, while Fig. 4 is a section of the log showing its construction. A centre rod of gun metal A. A. carries at one end the fork piece, B. B. which is slotted to receive the thimble on the end of the log line, as shown in detail in Fig. 4. The other end of the rod forms the spindle for the rotating head, C. C. provided with four blades set at the required angle and with ball bearing to receive the end thrust.

The center rod also carries the two vulcanite collars, D and D, between which the zinc tube, E, E, is clamped; a gun metal stud surrounded with a vulcanite bush is driven tightly into one end of the zinc, and this stud is in metallic connection with the contact spring, F, which normally rests on the vulcanite pin, G.

The revolving head carries at its base the worm, H, gearing into the worm wheel, J, which makes one revolution for every six of the revolving head, the spindle of the worm wheel projects, and is half filed away to form the cam, K, so as to rub against the contact spring once every revolution of the worm wheel, thus putting the zinc into contact with the center rod,

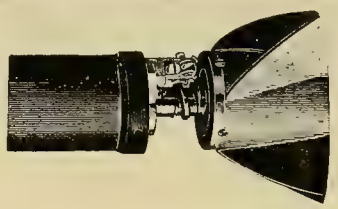


FIG. 5. NEW ELECTRIC LOG.

and so through the fork piece and brass thimble to the conducting tow line. A short brass tube, L, surrounds the working parts, preventing the entrance of sea weed, and yet, being readily removed, it permits the working parts to be freely accessible, as shown in Fig. 5.

The log line is composed of five copper wires spirally twisted round a strong core of hemp. This arrangement prevents any strain upon the conductors and gives flexibility. The whole is braided with strong twine. The five wires are bunched at each end, so that if four out of the five were broken the remaining one would be sufficient to keep up continuity. The sea end of the line is fastened round a brass thimble and the five wires soldered to it.

The indicator consists of a simple train of wheels driven by a spring and provided with an escapement actuated by the electro-magnet, so that one tooth of the escape wheel is released whenever contact with the zinc is made. The main spring requires winding every 500 knots travelled, or, say, daily. It will be seen from Fig. 6 that the log line is fastened to the log by a simple bolt and nuts.

The log has successfully undergone a series of Admiralty trials at Portsmouth, says the London *Electrical Review*, at all speeds up to 20 knots per hour. It was tried from torpedo boats and also from H. M. S. Barham. When first tried from a newly built torpedo boat no

FIG. 6. NEW ELECTRIC LOG.

current was set up, the cause being that most of these boats are built of galvanized steel, which practically means that instead of having a zinc-iron or zinc-steel couple, both electrodes were of zinc and consequently no current was generated. The cure proved most successful, for it perfectly sufficed to tow a short length of bare copper wire and to connect it to the indicator instead of using the ship's side. As a matter of fact it was found that with older terpedo boats, although of galvanized steel ample current is generated to work the indicator, no doubt due to the fact that the thin coating of zinc becomes to a large extent dissolved. During one trial the following were the means of several to and fro runs over the measured mile:—

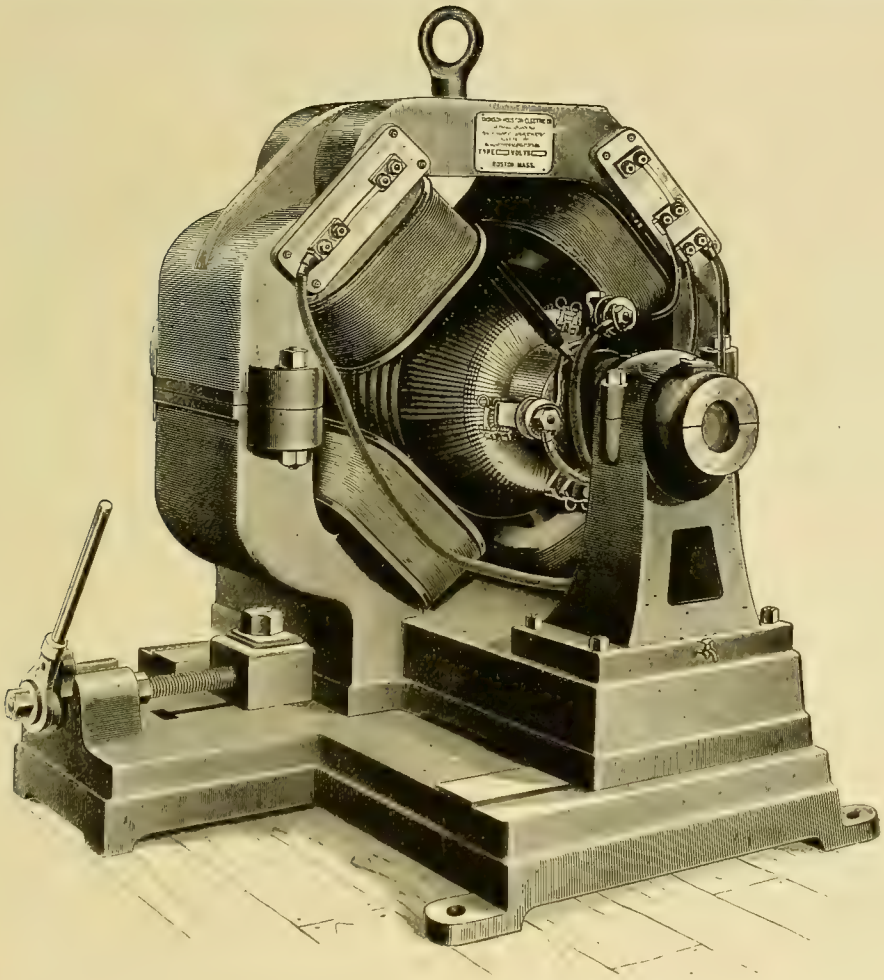
At speed of	6.8	kn's per hour	1.012	kn's regs'd.
" "	10.1	" "	1.008	" "
" "	13.6	" "	1.005	" "

Thomson-Houston Quadrupolar Electric Railway Generator.

To meet a constantly increasing demand for larger power units for railway service a line of multipolar generators, as they are called, has recently been developed by the Thomson-Houston Electric company. These generators are of the four-pole type. Some noteworthy features which the multipolar machines possess are the slightly lower speed at which they are driven, and the construction of the armature. This last named part of the machine is of the "ring" type, and therefore, dangers arising from a great difference of potential between any two of its conductors are greatly lessened. Making the armature in the form of a ring also facilitates repairs to individual coils.

The size most in use, which is termed "M. P.-75," is illustrated in the accompanying cut. This generator has an output equivalent approximately to 100-horse power. The speed of the armature is 750 revolutions per minute, and the normal voltage of the machine is 500. Four carbon brushes are used. The multipolar machines are separately excited, and the exciter employed is a small dynamo of the Thomson-Houston "motor type."

Another larger machine of the quadrupolar type which is called "M. P.-200," and develops something like 200 horse power, has also been constructed. In addition to this it is stated that a machine of 400-horse power for the West End railway in Boston is also under way.



THOMSON-HOUSTON QUADRUPOLAR ELECTRIC RAILWAY GENERATOR.

Cooperative Telegraph Company.

It is reported that a co-operative telegraph company has been formed in Pennsylvania by "practical operators," but officials of the Western Union company are not giving the scheme much thought. One of them said last week: "I don't see how such a scheme can be made a success. There have been three attempts in the last few years to organize similar companies, and they all failed sooner or later. There was one started in St. Paul and another in Michigan. Considerable money was put in the Michigan venture and it was afterward absorbed by the Merchants and Bankers' company, while that in turn was absorbed by the Western Union and postal companies. The St. Paul company never got far enough along to erect a single pole. The men who manage successfully telegraph lines have been acquainted with their management from messenger boys up. Mere operators are not fitted for the business. It requires a pile of money to put such a company on its feet, and men who have the money are not liable to venture on such a scheme with operators for managers."

Electrical Engineering in the University of Pennsylvania.

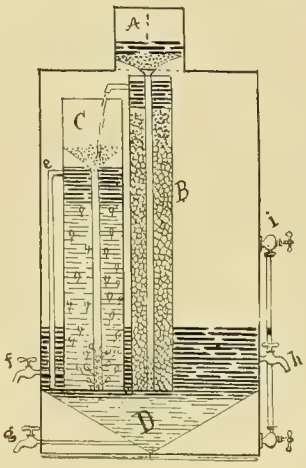
The University of Pennsylvania has issued a pamphlet outlining the course of mechanical engineering in that institution the coming year. Of the electrical engineering course it says: As the greater part of the education of an electrical engineer must be mechanical, and as no mechanical engineering education is complete without a good working knowledge of electrical engineering, a course, extending over parts of two years, has been established in this department. The work begins in senior year with a discussion of quantity, potential, current, resistance, electrostatic measurement, magnetism and magnetic measurement, electro magnetic measurement and the units adopted in practice. The course then treats of the measurement of currents, the construction, calibration and use of galvanometers, the measurement of difference of potential, quantity, resistance, a study of batteries, insulation test and the apparatus used the effects and measurement of electro-static capacity, the measurement and comparison of magnetic fields, the construction, testing and advantages of different ammeters and voltmeters, measurement of power and efficiency of dynamos and motors, the efficiency and life of incandescent lamps, and of the various carbons used in arc lighting. The theory of dynamo electric machines is taken up and the characteristics of each of the different types are studied Motors are studied in their theoretical and practical aspects. Lectures are given on electric lighting, including the most prominent arc and incandescent systems, wiring on the different systems, and the theory and practical management of accumulators. The course in the electrical laboratory covers the use of all the test apparatus for measuring currents, resistances, insulation and capacity, the testing of dynamos and motors, storage batteries and commercial ammeters and voltmeters. The apparatus in this department is being rapidly increased, and now contains Edelmann, Hartman, Thomson, d'Arsonval, and standard tangent galvanometers, Wheatstone bridge sets, resistance boxes and frames, condensers, voltmeters, ammeters, standard cells, special electrolytic cells, Bunsen photometer for arc and incandescent work, and all the keys, shunt boxes, telescopes, galvanoscopes, and scales necessary for carrying on the work of the course, in addition to primary batteries, secondary batteries, dynamos, motor, friction brakes, Emerson power scale, and floating dynamometer, etc., for power and efficiency tests. The classes will be limited in size, thereby having the work of each student carefully overlooked by the instructor in charge of the work.

New York Board of Electrical Control.

The recent disastrous storm in New York City impressed on the minds of the people of the metropolis the fact that electricity had become a necessity instead of a luxury. The *World* takes occasion to read the Board of Electrical Control a lecture on its policy on the subway question: Every particle of evidence which can be obtained indicates that the wires are not under ground because the Board of Electrical Control has not only failed to do its duty, but has, on the contrary, helped the companies to keep out of the subways. After the poles were chopped down the Board of Electrical Control insisted that the companies should give bonds for whatever rentals might be fixed. An exorbitant rental was fixed, and the companies protested and resisted. In the meantime they refused to give bonds on the basis of such a rental, and the result was that the wires were not buried. To further complicate the matter, the Board of Electrical Control undertook to make a new contract with a new company, a contract which Judge Truax now declares to be invalid. But it has nevertheless wrought confusion and delay. Now nature has come in and demonstrated that that delay has been exceedingly costly. It has shown how dear a luxury are overhead wires both to the city and the companies. The lights are out. The telephone is voiceless. The electric fire-alarm is a thing of yesterday. Fire-alarms are given by watchmen as in the olden day, standing in the dome of the Pulitzer building, and slowly transmitted by signal. Miles of wire and thousands of feet of poles are prone, and must be replaced at a large expense. And all this is due to the inefficiency of the Board of Electrical Control and to the greed of the corporations owning the wires.

Ellis Oil Filter.

The Ellis oil filter is illustrated diagrammatically in the cut. In the illustration, dark lines represent oil, light ones water. The oil to be filtered is first poured into chamber *A* where it passes though a sieve and downward through a small tube, at the bottom of which it is forced out through the openings and up through the filtering material; the oil then passes into *C*, where it is again strained through a finer sieve, and passing to the bottom of the tube, is forced out again and passes upward through water, thoroughly cleansing it and restoring it to its original color. At *E* it is again forced out and passes down into tank *D*, where it lies on top of water until drawn off through faucet *H* ready for use. The water gauge *I* shows the amount of filtered oil in the tank at all times. The faucets *F* and *G* draw the settlings from their respective tanks. It will be observed that in passing through the several forms of filtration, the oil always passes upward through its own pressure, thus leaving all sediment behind. The filter is handled by the Standard Oil Filter company, Chicago.



ELLIS OIL FILTER.

Electric Traction in Berlin.

The municipality of Berlin, Germany, has decided that no concessions will be granted for the construction of high-level electric street railways, or for electric tramways requiring overhead conductors carried on posts, erected either on the horse roads or footpaths. The city authorities of Berlin have lately been approached by exploiters of electric railway systems who sought to obtain the right to extend electric street railways throughout the city, but it would appear that all efforts have been fruitless. Berlin is without doubt a great city, but until now we would have deemed it preposterous

that any German city could have had the hardihood to attempt to outdo Boston in æstheticism. Think of Boston with its miles and miles of overhead electrical construction. Perhaps the city authorities of Berlin have never experienced the sensation of riding in a rapidly moving street car. Perhaps, after the World's Fair the Fatherland may awaken and grant concessions which will enable its citizens to obtain benefits, from one of the greatest applications of electricity.

The Healthfulness of the Electric Light.

The healthfulness of the electric light was recently illustrated in a striking manner. Some railway men were discussing in a car factory the relative advantages of illumination by gas and electricity, and the advocates of each system remained unconvinced by the other. Finally the superintendent of the factory suggested that the matter could easily be put to a practical test, and turning on the gas in the smoking compartment of an adjacent car he invited the officials inside. It is said their stay was of the briefest, for in a very few minutes even the strongest of them had to succumb to the heat and oppression and to seek the outer air. A like test made in a compartment lighted by electric incandescents was attended by a very different result, and the verdict which followed was unanimous for the cool, wholesome light. This will be readily understood by those who, accustomed to the electric light, have occasion to sit in gas-lighted rooms, in which the sense of heaviness often becomes oppressive.

CORRESPONDENCE.

New York Notes.

NEW YORK, Feb. 13.—Considerable trouble was experienced last Sunday and Monday both in this city and several other points throughout the state by the breaking down of electric wires under the heavy fall of snow. At Albany especially there was considerable trouble. A report from that city said: The telephone, telegraph, electric light and electric railway wires were so heavily loaded that they began to break and come down all over the city. In many cases the telephone wires fell across the electric trolley wires, burning out instruments and setting fire to the switch boards. The employees in the Central Telephone Exchange were kept busy extinguishing fires, and the city service, with its 1,500 wires, was practically useless. In addition to burning out the switch-boards in the office, the crossing of these telephone wires over the electric light and electric railway wires caused a number of light fires in buildings on the telephone circuit. The police and fire department wires are all burned out, and these two departments have to rely entirely upon messenger service. General-manager Uline, of the telephone company, requested Mayor Manning to order the power shut off both in the plant of the railway company and in that of the electric light company. The mayor did so, and before 10 o'clock the electric cars had stopped running and the city streets were in total darkness. But still the storm kept on. About 8 o'clock seven of the largest poles in the city, carrying 200 wires each, fell down into Montgomery street by the side of the Union depot, crushing a cab and shattering the windows in a number of houses along the street. Several people coming from the depot had narrow escapes from the falling wires, and one man was knocked down, but not seriously injured. The accident cut off the wires of the Postal Telegraph company and it is impossible to get a wire from their office to any part of the country. The Western Union office had only one wire working to New York City and that was overloaded with messages. The chief of the fire department established fire patrols at all of the engine houses.

A permanent organization of the Rapid Transit league of this city has been effected, and several committees have been formed. One of these committees is looking for permanent headquarters for the club.

W. H. T.

Kansas City, Mo.

KANSAS CITY, Feb. 10.—For the past week big white placards announcing the discontinuance of the system of transfers "to and from the Main street line of cable cars" have been posted in the cars of the Northeast electric line. It seems that hundreds of people living between Independence avenue and Twelfth street, East Side, who thought more of a nickel than of a few blocks' walk, have been in the habit of getting a ride down town and back home again for a single fare. The plan for beating the company was quite simple. A person living, say at Ninth and Indiana, would walk over to Twelfth street, and taking that car would ride to Main street, there a transfer to the Main street line would be obtained with an hour's limit in which to do shopping or calling. Riding to Fifth street on this check another transfer would be obtained to the Northeast line, also with the hour's time privilege, affording plenty of opportunity to do marketing or more shopping, and in that way the passenger would get back to Indiana avenue again and only a few blocks from the original starting place, and all for 5 cents. The scheme was a favorite one with women, and hundreds have availed themselves of it to the great pecuniary disadvantage of both roads.

In a very few days the southern extension or electric division of the elevated system will be put in operation. The line has been completed to its connecting point at Riverview and a gang of men has been placed on the line to prepare it for operation. The management of the new road believes that the enterprise will pay from the start and first-class car service will be provided. Power will be furnished from the engine house at the west end of the tunnel where two large Westinghouse engines have been installed. It was thought at first that this company would get its power from a local company, but this plan was abandoned.

The board of public works does not favor Representative Stone's electric light bill in its present form. The bill provides that electric light wires shall be placed underground before May 1, 1893. The electric light companies are given until May 1, 1892, to perfect a subway plan, and if they do not devise some scheme within that time, the local boards of public works are empowered to adopt systems of their own. President Cannon has written a strong letter to Senator Teasdale on the subject, and favors giving the electric light companies until 1893 to perfect their plans and until 1894 to bury their wires. In speaking of the matter President Cannon said: "All conduits, so far, have proven failures and the electrical engineers have been bending every energy to invent a perfect system of underground conduits and are still at work. It is nonsense to ask the boards of public works, which know nothing of the matter, o invent a scheme that electricians have failed to devise. Suppose we should get up a conduit, order it used and the streets should be blown up, why the city would be liable. Give the engineers time to invent and test a system, is what I am in favor of."

"Are you in favor of the city having control of the poles?" he was asked.

"Yes, I am," he replied. "I am in favor of licensing and taxing every telephone, telegraph and electric light pole. The city should have complete control of the wires and regulate the number and placing of the poles. Make several lines use one pole where necessary; remove useless wires and regulate and inspect the manner of running wires over public and private buildings."

Preparations for a fire alarm system were taken up for consideration at the last meeting of the Argentine, Kan., council. A proposition from the Gamewell company was accepted.

In the case of Charles E. Stauffer against the People's Railway & Electric Light & Power company, St. Joseph, Mo., a verdict of $25 was secured against the company. The action was based on the fact that the plaintiff had been ejected from a car because the "transfer ticket which he presented the conductor indicated that it had been held by the plaintiff an hour, whereas the rule of the company was that it should have been presented within fifteen minutes after it was given the passenger." The court instructed the jury that if the conditions of the ticket were not made known to plaintiff and were not printed on the ticket, the plaintiff was entitled to a ride on presentation of the transfer ticket to the conductor of the Frederick avenue line. This was a test case, and the company, no doubt, to avoid inviting further litigation, will be compelled to change its rules and regulations regarding transfers.

P.

Pittsburg, Pa.

PITTSBURG, Pa., Feb. 13.—A landslide occurred a few days ago on the Allegheny and Bellevue electric railroad, doing great damage to the tracks. The electric line runs for some portions along the slope of a hill, and it was here the hill suddenly gave way, leaving the tracks suspended in the air. The landslide was caused by unusually heavy rains. It will take considerable time before the damage can be repaired.

The manufacture of incandescent lamp bulbs is now being conducted in Pittsburg as well as in Corning, N. Y. Some of the striking glassblowers from the Houghton company have been transferred to the Macbeth & Co. factory in this city, and the manufacture of the bulbs is to be immediately commenced.

The annual meeting of the Allegheny County Light company was held last Tuesday. Four of the old directors H. H. Westinghouse, John Caldwell, Charles Payne and C. H. Jackson retired from the board. The new board elected consists of George Westinghouse, Jr., A. M. Byers, Robert Pitcairn, C. L. Magee, T. Sproull, John E. Ridall, William Eberhardt and G. H. Blaxter. Owing to the absence of Mr. Westinghouse the board will not organize until next week.

The annual report shows the company to be in a good financial condition and making money. The business of the company has been steadily on the increase since the first day it was started. Earnings from sales of light for twelve months in 1890 amounted to $310,256.24; operating expenses $199,041.77; gross earnings $111,214.47; less interest on bonds and mortgages, $44,025.41, leaving the net earnings for the year $67,189.06. To show how the business of furnishing electric light has grown the net earnings in 1887 were $9,545.96, in 1888 $15,303.29, in 1889 $47,322.96.

According to the financial statement the total assets are $1,286,408 08 divided as follows: Real estate, boilers, engines, etc., $405,168.65; electrical apparatus $367,782.86; construction $240,468.47; patents, charter, franchises, etc., $65,130; material on hand, $31,392.01; office furniture, etc., $3,306.32; horses and vehicles, $1,308,95; stocks and bonds, $16,061.25; accounts and bills receivable, $92,573.82; cash, $3,215.15.

Liabilities of the company are $1,154,439 73, leaving undivided profits of $71,968 35. The liabilities are divided as follows: Capital stock authorized, $1,000,000; capital stock in treasury, $500,000; capital stock issued, $500,000; bonds six per cent., ten years, $250,000; mortgage on Sandusky street premises, $17,500; accounts payable, $51,441 61; bills payable, $329 112.97; accrued interest on bonds and mortgages, $6,250; deposit account, $135.15.

The comparative statement of incandescent lamps operated is interesting. In 1887 the number in use was 10,511; in 1888, 20,145; 1889, 27,829; 1890 33,500; arc lamps operated in 1890 amounted to 857. Since December 1 applications have been received by the company for 2,000 additional sixteen candle power lamps.

Superintendent Bowers, of the Bureau of Public Light in this city, has just submitted his annual report. The report shows that during the year the city paid $7,552.87 to the Allegheny Light company, $130,099 72, to the East End Electric Light company and to the Pittsburg Electric Light company, $988.72, making the total expenditure for the lighting, $139,883 20. The total expenditure by the bureau amounted to $141,803.91. The report also shows that there are 920 arc lights in the city, 280 incandescent lights and 2,917 gasoline lamps.

E. H. H.

Louisville, Ky.

LOUISVILLE, Ky, Feb, 12.—Hardin H. Littell of the Louisville City Railway company said a few days ago that the Fourth street line would be operated by electricity within three weeks. Already the workmen are stringing the double trolley wires for the Fourth street line, and are getting ready to make the change on the other lines as soon as possible. The six lines to be changed first, however, will not all be completed until about April 1. Work on the two power houses is being pushed,

At Salem, Ind., the Salem Electric Light & Artificial Ice company has made a contract with the general council for the exclusive right to furnish electric lights there for ten years. Ten arc lamps have also been contracted for at $75 each per year. The company will commence work on a $20,000 plant at once.

The Gooch Electric Light company in this city had some trouble with the property owners along its right of way granted by the council for the purpose of putting up poles and stringing electric light wires. There have been concessions on both sides, and the work is proceeding uninterruptedly.

At Danville, Va, February 6, the electric plant of the street railway company was destroyed by fire. The loss is about $20 000.

In addition to the new gas plant of the Gas Light & Coke company of New Albany, Ind., the electric light plant has been materially extended. Since February 1 the company has been able to furnish either arc or incandescent lamps to any number likely to be needed in that city. The price for the arc lights to commercial consumers is $6 a month for each lamp, a reduction of over 20 per cent. from former rates. A number of the incandescent lamps have been ordered for private residences, as they are quite as cheap as gas in that city. The electric light plant now consists of a large battery of boilers, furnishing ample steam power, four engines and five dynamos of a capacity of 1,750 incandescent, and 110 arc lamps.

Henry Kramer, an electric light lineman, was shocked by a wire while working at the New York store here last week, and was temporarily crazy. He has recovered his reason, but is in a bad condition physically. He has begun a suit.

J. W. L.

THE ELECTRIC LIGHT.

The new electric light plant at Crete, Neb., consisting of twenty 2,000-candle power arc lights for street lighting and fifteen arc lights for stores, is in operation. The plant was installed by the Brush company of Cleveland.

The Berlin, Wis, Electric Light & Power company has been formed, capital stock, $15,000; Hiram Stedman, president, John J. Wood, Jr., secretary; John C. Culver; superintendent; H. M. Forbes, electrician. One National and one Western Electric dynamo have been installed, giving a capacity of 30 arcs and 750 incandescents.

The Concord, N. H., Electric Light company has purchased a Reynolds Corliss engine for its new central station, also two 14-foot horizontal fire-box boilers. The station will be started in the spring.

The Jamaica exhibition was opened at Kingston, January 27th, and, according to a correspondent, there was a fine display of electric lighting. The grounds cover an area of 23 acres, and are brilliantly illuminated with electric lights. The building is cruciform, with long arms running east and west. On the ends are entrances, comprising vestibules screened by pillars and arches. The short arms, or transepts, point north and south, and have vestibule entrances similar to the former. At the point of intersection the building rises up into a magnificent dome, which from the lantern to the floor is about 100 feet. The building is lighted throughout with the electric light, an arc light is hung in the cupola and is visible from all points of the compass, and an electric search light is placed in one of the mirrors.

It is probable that the electric light companies of Milwaukee will be greatly benefited by the discovery that has been made in connection with the city gas contracts. In order to patronize a home industry the third ward for years has not only had more gas lamps than any other section of the city of like size, but ordered six-foot burners in order that the proper illumination might be obtained. Recently a suspicion was aroused that the ward was not receiving all the gas it paid for. An expert was secured, who tested the burners and found them all five-foot instead of six, as called for in the contract. A little mathematical calculation showed that the ward under this state of things had paid the gas company something like $50,000 more than it should. The gas company tells another story. The company admits that the tips are five-foot, as charged, but claimed that the light called for is secured by a greater pressure. There the matter rests now, but an investigation will be made by a council committee to discover whether the generosity and confiding nature of the Third warders has been abused.

THE ELECTRIC MOTOR.

The Ridge Road Improvement association, Rochester, N. Y., has appointed a committee to secure the right of way for an electric railway.

A charter has been applied for by five prominent capitalists of Nashville, under the title of the Cumberland Navigation company. The object of the company is to operate electric motor boats on the Cumberland river, under patents recently granted to one D. W. Cook.

The United States Trading company has been incorporated at Chicago; capital stock $100,000, for dealing in merchandise and the manufacture of railway supplies and appliances and electric appliances; incorporators, Lawrence W. Tatum, Samuel T. Street and Alfred D. Eddy.

A dispatch from Bay City, Mich., says: The Union Street Railway company of this city is soon to appoint a committee to confer with a like committee already appointed by the West Bay City Electric Street Railway company to consider the matter of consolidation. In case satisfactory terms can be agreed upon the companies will be amalgamated.

At the initial meeting of the incorporators of the Metropolitan Street Railway company of Omaha, Neb., these officers were elected: President E. S. Rood; vice-president, Edward A. Cudahy; secretary, T. J Mahoney; treasurer, William Paxton. Negotiations have been commenced for construction and supply contracts. The equipment will be for horse and electric power with the object of finally using storage batteries. Work will be commenced at the earliest possible moment, and will be pushed to completion as rapidly as possible.

The Supreme Court of the United States has rendered a decision in the case of Sioux City, Ia., against the Sioux City Street Railway company. The opinion is by Justice Blatchford and affirms the decision of the Supreme Court of Iowa. This settles an important contest not only for Sioux City, but for every other city in Iowa, which had a street railway in operation prior to the passage of the law by the state general assembly requiring street railways to pay for paving one foot on each side of the tracks. When Sioux City did its first paving this law was in effect and the Sioux City Street Railway company was assessed under its provisions for paving one foot on each side of its tracks. The company claimed that as it held its franchises and was operating its lines before this law was passed, it was not affected. There was quite a difference of opinion between the city officials themselves as to the applicability of the new law to this case, and suit was brought in the District Court to determine it. It was argued before Judge Wakefield, and he decided against the city. The case was appealed to the Supreme Court of Iowa, where Judge Wakefield's opinion was reversed. The street railway company refused to consider this decision as final and carried the case to the Supreme Court of the United States with the result already stated.

Miscellaneous Notes.

Howard Hall of Bridgeport, Conn., claims the distinction of being the first man on record to have his shaving done by electricity. Hall was tending a motor last week when a spark cleared his face.

The Western Electrical Supply company of Chicago has been incorporated to manufacture and deal in electrical supplies, etc.; capital stock, $30,000; incorporators, William H. McKinlock, William Alton, Jr. and John McKinlock.

The suit in interference between the Triumph Compound Engine company of Cincinnati, and the Westinghouse Machine company of Pittsburgh, relating to double acting compound engines, has been decided in favor of the former company.

A Washington correspondent writes: A bill has been introduced in the Senate to incorporate the National Electric company to lay underground conduits etc. The capital stock is to be $250,000, and the incorporators are A. A. Pope, of Boston, Mass; W. S. Opdyke, of New York; R. F. Henry, of St. Paul, Minn, and others.

Dealers and jobbers in rubber goods of all description have been watching with interest the war that has been conducted for some time between two of the largest houses in the country. It is expected that the controversy will be kept up for some time yet, but there is little hope the electrical manufacturers will be benefited thereby.

The Wisconsin Telephone company held its annual meeting Feb. 9th and elected the following officers: President, Henry C. Payne; vice-president, C. H. Haskins; secretary, J. D. McLeod; treasurer, F. G. Bigelow; directors, F. G. Bigelow, George Albree of Chicago, B. K. Miller, H. C. Payne, C. H Haskins, Charles Ray and D M. Benjamin The board of directors was increased to seven by the addition of two new members: These were Ray and Benjamin. All the other officers were re-elected.

A Washington paper says: The public has been favored with brief reports of what have been done, or rather of the way in which the time has been squandered in the committee on postoffices and post roads this session, the bone of contention being Mr. Wanamaker's limited postal telegraph bill. Messrs. Bingham and Ketcham have led the obstruction to its consideration. It now appears that W. W. Dudley, who has been managing the campaign against the bill, has been provided by the Western Union company with an extra fund of $50,000 to work up an opposition to it. Strange as it may seem, Mr. Dudley has had the aid of Mr. Clarkson. Another re-enforcement to the lobby is Mr. Moore, of Moore & Schley, who directly represents Mr. Gould, and has a separate fund besides the $50,000 placed in Mr. Dudley's hands. The statements have created quite a flurry in government circles at Washington.

A dispatch from Washington says: The United States Supreme Court yesterday announced some important changes in its rules designed to meet cases brought before the court principally for the purpose of delay. The changes are framed specially to meet habeas corpus cases, and are the result of the Jugiro electrocution case in New York. It is hoped that these modifications of the rules will obviate the necessity for congressional legislation. The most important change made is the addition of a requirement that all appeals, writs of error and citations, unless specially ordered otherwise, must be made returnable to the Supreme Court within not exceeding thirty days, whether the court is in session or in vacation. Unless the record and case is docketed within this prescribed time the case must be dismissed by the court if it be in session, and by the clerk during vacation time. The effect of these modifications will be to bring every case before the court within thirty days from the time of the decision of the lower court, except where, for good reasons, an exception is made. It is also not improbable that these changes will shorten the docket of the court, and be of material assistance in enabling the body to keep up with current business.

J. Miller, a St. Louis lineman, gives the following expression of opinion on the subject of disposing of electric wires: Everybody is discussing the proposition to put the electric wires underground now, and most people favor it, but if great care is not exercised in the matter the danger will be increased instead of lessened. The whole danger can be averted by putting the small wires underground. The large wires, such as electric light wires, should be left overhead The danger comes from wires breaking and crossing. The large wires do not break, and there is no danger in leaving them everhead If the electric light wires are put into the conduit underground with the small wires the insulation will rot off in time, and the current will be taken up by the small wires. Then it will be worth a lineman's life to go down into a manhole to rectify matters. The only way that all the wires can be put underground together with safety is by making the conduits so large that cross-trees can be erected in them, the same as they are now overhead, which would allow the wires to be kept apart. This is done in Madrid and Paris, but in this country the conduits so far constructed have all been too small to allow such an arrangement. I have worked in these small conduits where all sorts of wires were strung together, and although I have escaped injury myself I have seen other men roasted alive in them, and know what the danger is.

Personal Mention.

Samuel Insull, John Muir, J. C. Henderson and John Kreusi of the Edison General Electric company, New York, were in Chicago last week.

E. C. Noe has resigned his position with the Canadian General Electric company, Toronto, to accept the position of superintendent of construction of the western department of the Thomson-Houston company, Chicago.

H. K. Gilman, general manager of the Great Western Electric Supply company, Chicago, represents the interests of his company at the Electric Light Convention.

The American correspondent of the London *Electrician* has this to say of Prof. Barrett, the head of the department of electricity of the World's Fair: "His appointment will mean a vigorous and successful administration of the electrical section. Mr. Barrett is a man of great executive ability, and his long connection with the city of Chicago as superintendent of of its police and fire-alarm systems, and of its electric lighting and power plants, has given him a firm grasp of the practical side of electricity and an intimate knowledge of American electrical companies and their peculiarities."

Since the death of Secretary Windom there has been much speculation regarding his successor. The latest bit of interesting gossip on this subject comes from St. Paul: Senator Pierce of Minnesota presented to the president the name of Thomas Lowry, the generalissimo of the electric street car service throughout the Northwest, for secretary of the treasury. The president evinced so much interest and asked so many questions concerning Mr. Lowry that Senator Pierce was encouraged and consulted with Senators Davis and Washburn. Mr Lowry was interviewed and said: "There is nothing in it at all. There is no real good reason why it should be offered to me; I have never figured in politics. I don't see how I am fitted for it. It looks as though some one was poking fun at me."

Business Mention.

Herbert Turner, representing Woodbridge & Turner, electrical engineers and contractors of New York, has opened an office at 356, The Rookery, Chicago.

The Weston Electrical Instrument company of Newark, N. J., manufacturers of Weston's standard voltmeters and ammeters, will be represented at the convention. This progressive concern is doing a big business. Their goods are exceedingly popular.

The continued prosperity of the Great Western Electric Supply company, is a marvel to its friends. It is being very carefully managed in both its business and financial departments, and is destined to become one of the greatest supply houses in the country.

J. Lang & Co. of Chicago, have within the past week shipped six of their improved main line switches to the Sioux City Light & Supply company of Sioux City, Iowa. These switches were of the same pattern as those recently placed in the South Side Edison station, for which this firm has received much praise for the beauty of the work and the high efficiency reached.

The Great Western Electric Supply company is manufacturing its own specialties, among which may be mentioned a trolley wheel, composed of aluminum and a secret compound, porcelain switches, cut-outs, etc. They have also a new carbon battery, which is said to be one of the best yet put upon the market.

The New York Belting & Packing company, 15 Park Row, New York, manufactures everything in the way of vulcanized rubber goods for mechanical purposes, and its celebrated rubber belting, packing, hose, and mats and matting have attained an enviable reputation for durability and high class workmanship, both at home and abroad.

Messrs. Cooper & Morrison, agents of the Fort Wayne Electric company at Buffalo, N. Y., report the following orders for the past six weeks: Jamestown, N. Y., 150 arcs; Batavia, N. Y., 120 arcs; Warsaw, N. Y., 60 arcs, and 750 alternating; Niagara Falls, Ont., 60 arcs; Buffalo, N. Y., for the United States Electric Light & Power company, 80 arcs.

A thoroughly reliable, safe and durable steam boiler is a necessity for electric light and power stations Such a one can be found in the Root new water tube safety boiler, manufactured by Abendroth & Root Manufacturing company, 28 Cliff street, New York, and is adopted by the many Edison companies in various cities. Catalogues will be sent on application.

The Great Western Electric Supply company, Chicago, have en route a train of cars containing wire from Holmes, Booth & Haydens and the Safety Insulated Wire & Cable company, both of New York. The company expect to carry at all times a stock of supplies aggregating about $300,000, and believe that they can fill any order from stock within twelve hours after its receipt.

James H. Mason and C. A. Morse, of the Simplex Electrical company, were in Chicago last week. They arranged with George Cutter to act as general Western agent for Simplex wire. They have just made a circuit of the West and find that many electrical people, realizing the true value of a first class insulation, are using Simplex wire where a high and lasting insulation is needed.

A steam pump, which has met with great success in electric light and power stations for boiler feed purposes, is the Davidson, manufactured by M. T. Davidson of Brooklyn, N. Y. This pump has been upon the market for some time, and has a high record for simplicity and durability, and efficiency. It is very popular, both with manufacturers generally and mining men.

The natural non conducting, fire and waterproof properties of asbestos fit it especially for use as a covering for steam pipes and boilers. Fire Felt, a new boiler covering, manufactured by the Chalmers Spence company, 5961

Liberty street, New York, is made entirely of asbestos, and is becoming very popular. This concern is the largest manufacturer of asbestos goods in the United States.

The Railway Department of the Electrical Supply company, Chicago, is now in complete operation, and is prepared to fill the largest orders on the shortest notice. This department has already worked out a number of advanced ideas in railway appliances, and has in progress, various new devices and improvements in old ones which will materially aid the development of this branch of electrical work.

The Illinois Electrical Material company has recently issued a new catalogue that is a model of beauty and which leaves nothing to be desired in completeness of detail. A large line of street railway and electric light supplies which this company has in stock is illustrated in a complete manner, each department having assigned for it an individual space in the catalogue, with a classified and alphabetical index. The book is printed in mauve ink on super-calendered paper, and is really a work of art.

The Belding Motor company has a large force of men engaged in the rebuilding of its factory recently burned, and hopes to have everything in readiness to resume work in about thirty days. While the building was badly damaged the new machinery that had just been placed when the fire occurred came out in very much better shape than was feared, so that the delay and loss will be less than was anticipated. The grit and energy shown by the officers of this company are to be highly commended.

Benj. R. Western, proprietor of the Manufacturers' Advertising Bureau & Press Agency, 111 Liberty street, New York City, who attends to the advertising and general newspaper work for many large manufacturing and electrical concerns, will be on hand at the convention of the National Electric Light association at Providence. Mr. Western's bureau is a boon to busy men who want to be relieved of their newspaper work and advertising, with the assurance that it will be well and profitably attended to.

A very unique and effective example of decoration may be found in the superb assortment of elk heads which are among the treasures stored at Nos. 190 and 192 Fifth avenue, Chicago. These heads are wired and the horns fitted with lamps, and when lit the effect is very beautiful. It is one of the oddest and most attractive uses to which electricity has been applied, and there are perhaps no finer collection of elk heads in the country than those owned by the Great Western Electric Supply company. They range in value all the way from $75 to $500, and it is said their sale far exceeds the supply.

The Central Electric company of Chicago, is having a large demand for its new ammeter and voltmeter illustrated in the WESTERN ELECTRICIAN two weeks ago. Orders are coming in from every section of the country, which shows that a reliable and moderate priced instrument of this kind has been needed. The company report unprecedentedly large sales of okonite and improved Candee wires. From the nature of the orders that have already been received during the month of February, the indications are that a very large amount of high class construction will be done as soon as the spring opens.

The Chicago Wood Mat company has just completed an order for the Rapid Transit Railway company of Newark, N. J., placing a new design of flooring and mat combined in eighteen electric cars. This style of flooring has been adopted and is being largely used by the Pullman company, an order having been recently received through them for 100 cars now in operation on the Duquesne Traction company's lines in Pittsburgh. This style of mat is particularly well suited for electric cars owing to the fact that it is rigid, allowing a trap to be cut through and easily managed for necessary inspection and repair of the motors. The office and factory of this company are at 247 No. Wells street, Chicago.

The Chicago Rawhide Manufacturing company is meeting with marked success in the introduction of rawhide belting for the driving of generators, both for electric lighting and for electric street railway work. Some fine sales have been recently concluded, and the users have voluntarily furnished excellent testimonials as to the lasting qualities and efficiency of the belting. This company states that it is the only concern in the United States making a rawhide belting, its invention being protected by numerous patents, not only for this particular line, but for the use of rawhide for harness leather, farm whips and a large number of specialties. Mr. Andrew B. Spurling is president of the company and Wm. H. Prebie secretary, the latter gentleman having the active management of the business, which has grown since its inception in 1878 until now it is one of the leading establishments of the city.

The Central Electric company has just received the following letter from Prof. H. S. Carhart of the University of Michigan, Ann Arbor: "Some time in the la ter part of 1887 the Central Electric company sent me a coil of 1,000 feet No. 18 B. W. G. braided Okonite wire, to be used in measuring insulation resistance. For more than six months of the time since it has been under water in a tank. Its insulation resistance has increased rather than the reverse. At present it measures 16,000 *megohms per mile* at a temperature of 17°C. Mr. Patterson, instructor in physics in my laboratory, has devised a new and improved method of measurement, by which the percentage of error is much reduced. I can therefore give the above result with much more confidence than if the old methods had been used. The capacity of the 1,000 feet is 0.082 of a microfarad."

M. C. Chase, 43-45 South Canal street, Chicago, has succeeded in establishing a highly satisfactory business in the manufacture of specialties in hard rubber, and is prepared to furnish details and estimates at short notice for anything in this line. Mr. Chase has held a fine trade in a standard line of push buttons, bushings for screw head insulation, battery boxes, etc., which he has manufactured largely for the leading electrical companies. He has also patented some useful appliances, which are now being brought into use, the most important of which is a safety binding post for use on high tension machines. These binding posts are incased in hard rubber, and can be made any size desired. Mr. Chase was formerly at 84 Market street, but finding his business outgrowing his facilities he has recently moved into some fine new rooms in the Metal Workers' building at the number indicated.

Queen & Co. of Philadelphia state that their exhibit at the Providence meeting of the National Electric Light association promises to be most interesting. They will show a full line of their special instruments, and also a series of their new magnetic vane ammeters, which are specially intended for central station use. Regarding these ammeters, the Brush Electric company of New York say in a recent letter: "We very cheerfully state that your ammeters as used by us have worked accurately, and given most excellent satisfaction." Queen & Co. have just completed negotiations with Profs. Bristol and Geyer of Hoboken for the control of their patent, which covers a new form of recording ammeter. These instruments are not yet perfected, but they promise well, and there is certainly a great demand for a reliable recording meter. E. G. Willyoung expects to look after the interests of the firm at Providence, and will be much pleased to receive a call from those in attendance, and their friends. The exhibit will be in a most prominent position,

The Triumph Compound Engine company of Cincinnati wrtes: We have just sold an engine to Uruguay, South America, for electric lighting. We are informed that our engine driving the dynamos in the concentrating mill of the Butte & Boston Mining company, Butte City, Mont., is giving the best of satisfaction, the engineer writing that "The compound electric light engine is in use. It does not give a particle of trouble, and is easy to steam." The Weir Frog company of Cincinnati writes concerning our 125-horse power engine: "In response to your inquiry we would say that your 9x18x10 compound engine running at 325 revolutions, with which you replaced our slow speed releasing valve gear, has now been running for two months to our perfect satisfaction. It is doing about a third more work with same or less fuel consumption than obtained with our former engine. Although running at high speed, the construction is such that the engine is perfectly steady, and there is no evidence of the strain usually attendant upon such speed. It occupies small space in our works, and requires but little attention on the part of the engineer."

The Crocker-Wheeler Motor company manufactures machines adapted to almost every possible case, and they are made to be run from any practical electric circuit. This includes constant potential or incandescent circuits of any e. m. f., from six to five hundred volts, and constant current or arc circuits of any current from six and one-half to twenty amperes. In suiting these motors to the work for which they are intended, they are constructed in six different ways. The six types are distinguished by the initial letters of their most important characteristic, viz.: The "C" or constant speed motors are the ones most commonly used. They are suitable for all constant potential circuits, and in running never vary more than from five to ten per cent. in speed between running free and full load. They are used on most ordinary work The "S" or series motors are used chiefly for special work, such as driving fans attached directly to the shaft, and for applications where they can be geared. Their winding is simpler than the others, but they do not control their speed if the work is irregular, and will speed up indefinitely if the belt slips off. The battery motors are made of this type, because they draw more current from the battery when slowed down by heavy work, and therefore vary their power as required. The "T" or two speed motors are suited to the same classes of work as the "S" motors. They are series wound and are provided with a simple switch by which the change from slow to full speed is made instantly. The "R" motors are reversible, and therefore very convenient for a great many kinds of work requiring changes of direction of motion. They are provided with reversing regulators by which they are first slowed down, stopped, reversed, slowly started, and then run at full speed, according to the movement of a switch which is arranged precisely like the reversing lever of the steam engine. When finally brought to full speed in either direction the speed is constant as with the "C" motors. The use of these machines for securing reversing motion saves all cross belts, reversing clutches, etc.

Electrical Patents.

Issued February 10, 1891.

445,969. Electric Insulator. James Branch, Richmond, Va.

445,991. Electro Mechanical Indicator for Fire Alarm Telegraphs. Thomas F. Gaynor, Louisville, Ky.

446,030. System of Electrical Distribution for Mines. Elmer A. Sperry, Chicago, Ill.

The claim reads:

"In a system of electrical distribution for mines, the main conductor leading down the main entries, branch conductors leading down the butt-entries derived from said main conductors, and ammeters located at the junctions thus formed, in combination with machines for both mining and transporting, deriving their energy from the same wires."

446,031. Electric Switch. Elmer A. Sperry, Chicago, Ill.

The fourth claim reads:

"In a contact making device, a rotating stem, a cam mounted loosely thereon. a pin in the stem, the end or ends of which are bent so as to be on a tangent, and means on the cam for engaging such pin."

446,037. Extensible Bracket for Electric Lamps. Jonah E. Titus, Orange, Mass.

446,092. Dynamo Electric Machine and Electric Motor. Edward K. Brown, Brooklyn, N. Y.

446,294. Electrode for Secondary Batteries. Marmaduke M. M. Slattery, Fort Wayne, Ind.

446,108. Electric-Arc Lamp. Richard H. Mather, Windsor, Conn.

The last claim reads as follows:

"17. Upon the feeding-rod of a focusing electric arc lamp, a sleeve formed of two independently-rotatable parts which are provided with pins radiating therefrom, in combination with a locking-sleeve which is provided with slots for the accommodation of said pins."

446,109. Arc Light. Richard H. Mather, Windsor, Conn.

Claim 7: In an electric arc lamp, a four-contact switch whose actuating-magnet is wound with two helices arranged in parallel with each other and with the carbons of the lamp."

446,130. Lightning-Rod. George W. Downey, Hyattsville, Md.

This invention consists in a lightning-rod section, comprising a piece of sheet copper, angularly bent, and twisted into spiral form and having corrugations between its angles and a small space between the adjacent edges of the said strip of metal.

446,142. Electric Signal and Search-light Lantern. George W. Martin, Somerville, Mass.

446,159. Switch and Signal Apparatus. George Westinghouse, Jr., and Jens G. Schreuder, Pittsburg, Pa.

'18. The combination, with a slotted quadrant having locking-stops located within the slot, of an electrically-controlled latch adapted to engage said stops, a lever for operating the quadrant, provided with spring-actuated pin or pawl, and shoulders or stops formed on the front plate of the machine."

446,174. Electric Cooking apparatus. Jeremiah O'Meara, New York, N. Y.

Claim 2 reads: "A portable heating apparatus comprising a case or jacket, an enameled vessel, and interposed electric conductors arranged externally of the enameled vessel, substantially as described, whereby the said apparatus may be used with an electric or other heating agent, or both."

446,180. Insulating Coupling Block and Cut-Out. Sigmund Bergmann and Charles S. Klein, New York, N. Y.

446,188. Telephone Transmission. James W. McDonough, New York, N. Y.

Claim one is as follows: "This method of transmitting sounds electrically, consisting in producing changes in the intensity of a magnetic field corresponding to the character of the sound-vibrations, revolving a magneto-electric armature in said field by any suitable power, and delivering the variable currents as produced to a suitable receiving-instrument."

446,199. Multiple Call-Box. Frank B. Wood, New York, N. Y.

446,200 Fire Indicator and Extinguishing System. Stephen Broichgans, Milwaukee, Wis.

446,208. Automatic Weighing-Scale and Indicator. Adolph B. Rover, Binghamton, N. Y.

446,212. Heat-Regulating Apparatus. George L. Shorey, Lynn, Mass.

446,214. Method of Laying Electric Cables. Charles H. Wilson, Chicago, Ill,

The invention consists in blocks or wedges as used in conduits for the purpose of arranging the cables in line throughout the length of the duct, so that one cable may be drawn in after another without obstructing and without abrading one another, and so that any cable may be drawn out likewise without injury or unnecessary friction.

Claim 5 reads: "A duct containing cables partially filling the same, and a movable wedge corresponding in size to the margin or space remaining in the duct, said wedge being combined with said duct."

446,229. Regulator for Electric Motors. Lander S. Harris, Detroit, Mich.

446,245. Electric Locomotive. George R Baldwin, Montreal, Canada.

446,284. Automatic Potential Regulator for Electric Currents. Alviruf Lonzo Ellis, Kansas City, Mo.

446,297. Electric-Arc Lamp. Carl J, Schwarze, Brooklyn, N. Y.

446,295. Arc-Light System. Carl S. Schwarze, Brooklyn, N. Y.

446,313. Electric Signal System for Railroads. Edgar C. Wiley, Briston, Tenn.

446,376. Electric Railway and Contract Device Therefor. Edward M. Bently, New York, N. Y.

'Claim 2: The combination, in an electric railway, of a conduit outside the railway track and a contract device adapted to ride upon the conduit and having a lateral flexible connection with the vehicle."

446,403. Track-Instrument for Railway-Signals. Mahlon S. Conly, Chicago, Ill.

The prime object of the invention is to dispense with the employment of a vibrating bar in operating a track-instrument secured directly to the rails, and to utilize the difference in movement between two parts of the rail through the instrumentality of a bar, also rigidly secured to the rail, for operating a track instrument.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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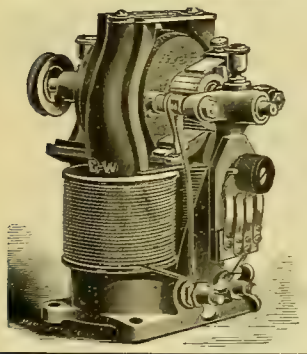

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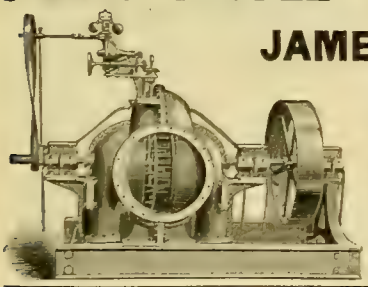

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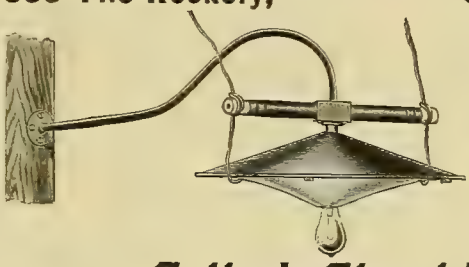

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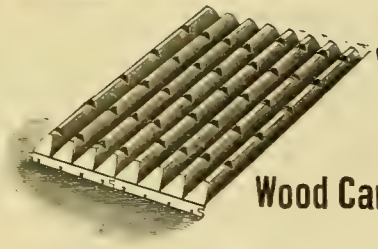

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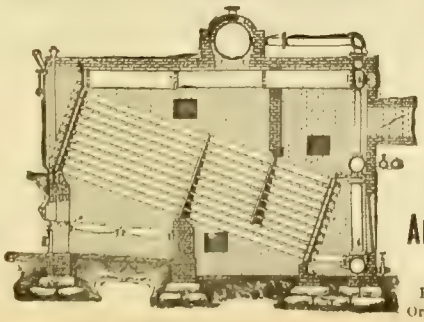

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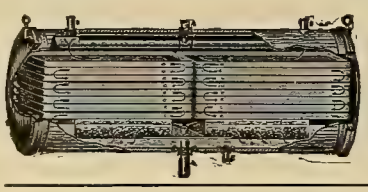

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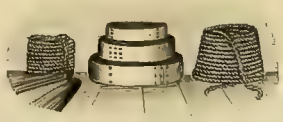

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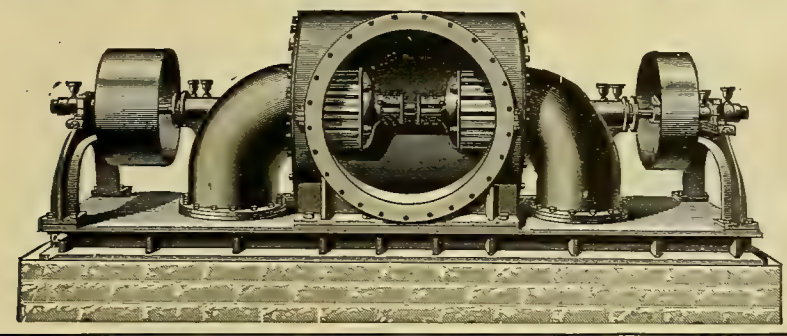

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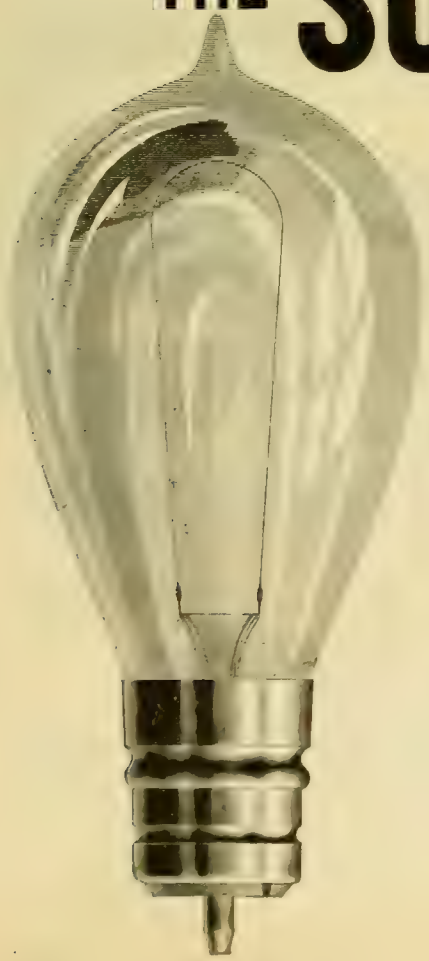

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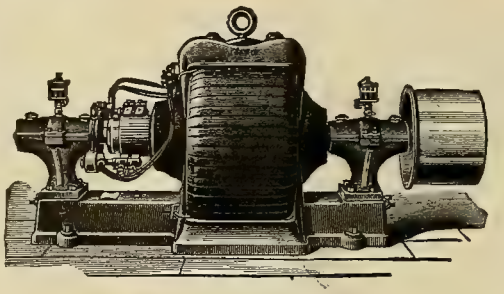

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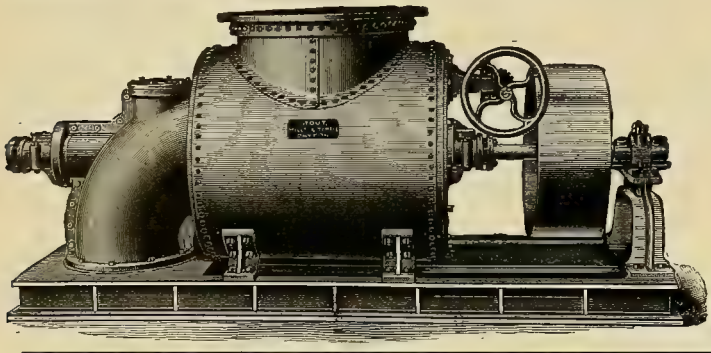

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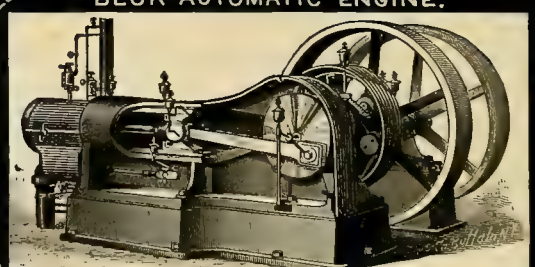

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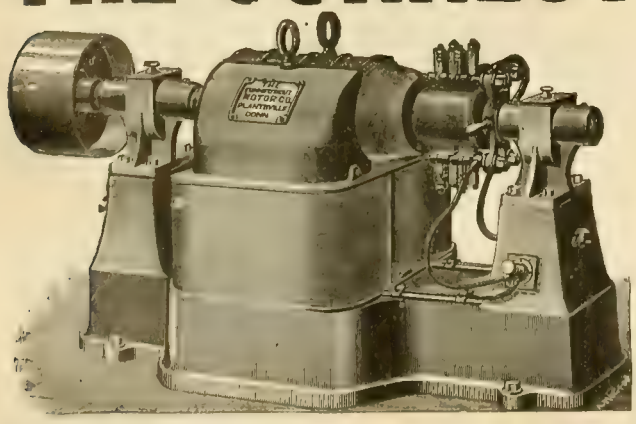

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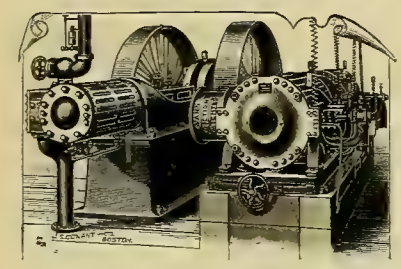

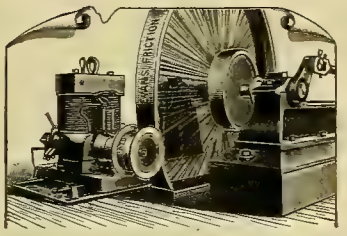

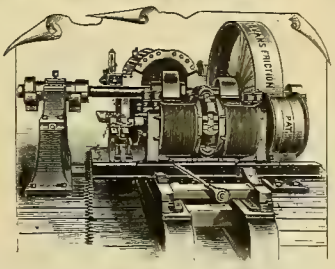

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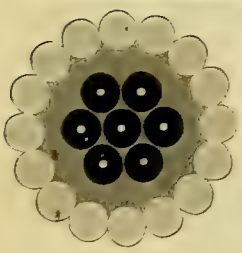

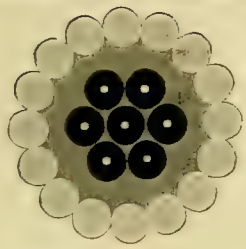

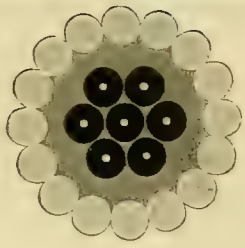

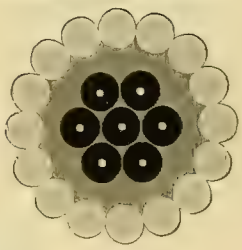

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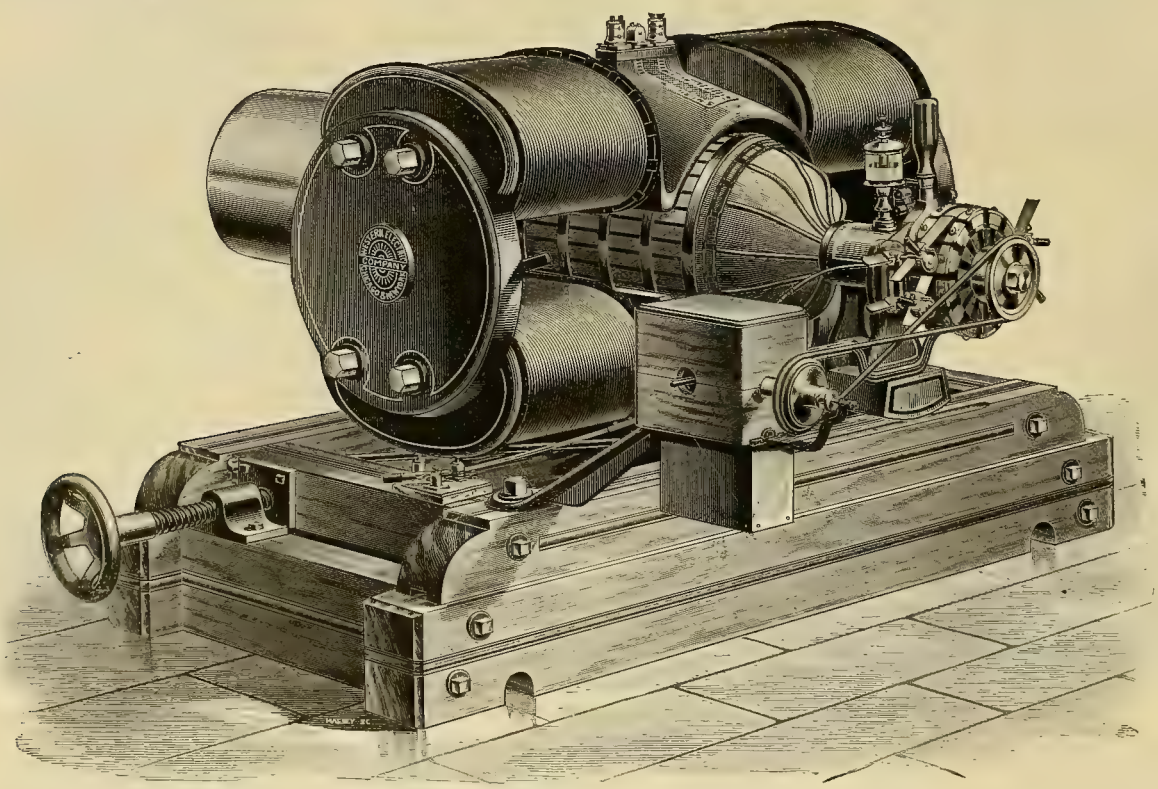

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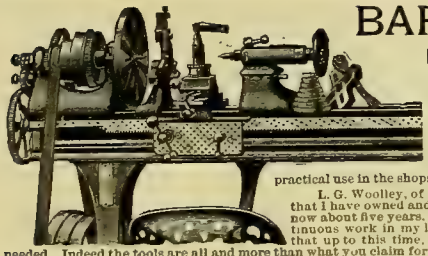

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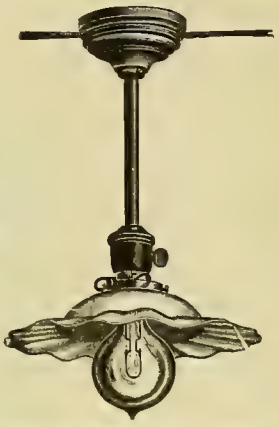

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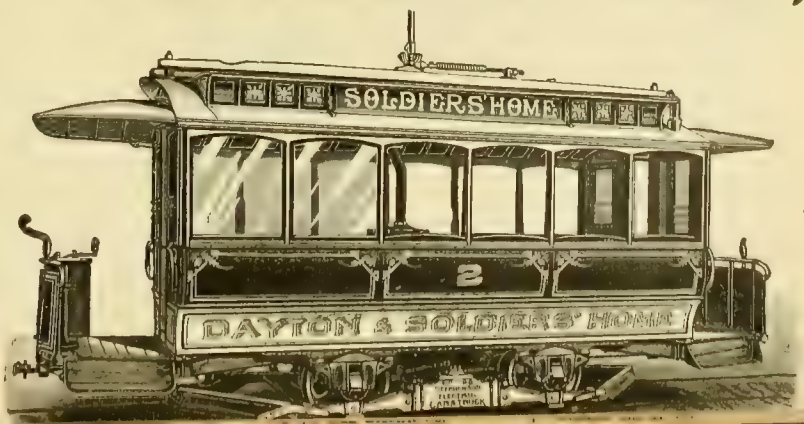

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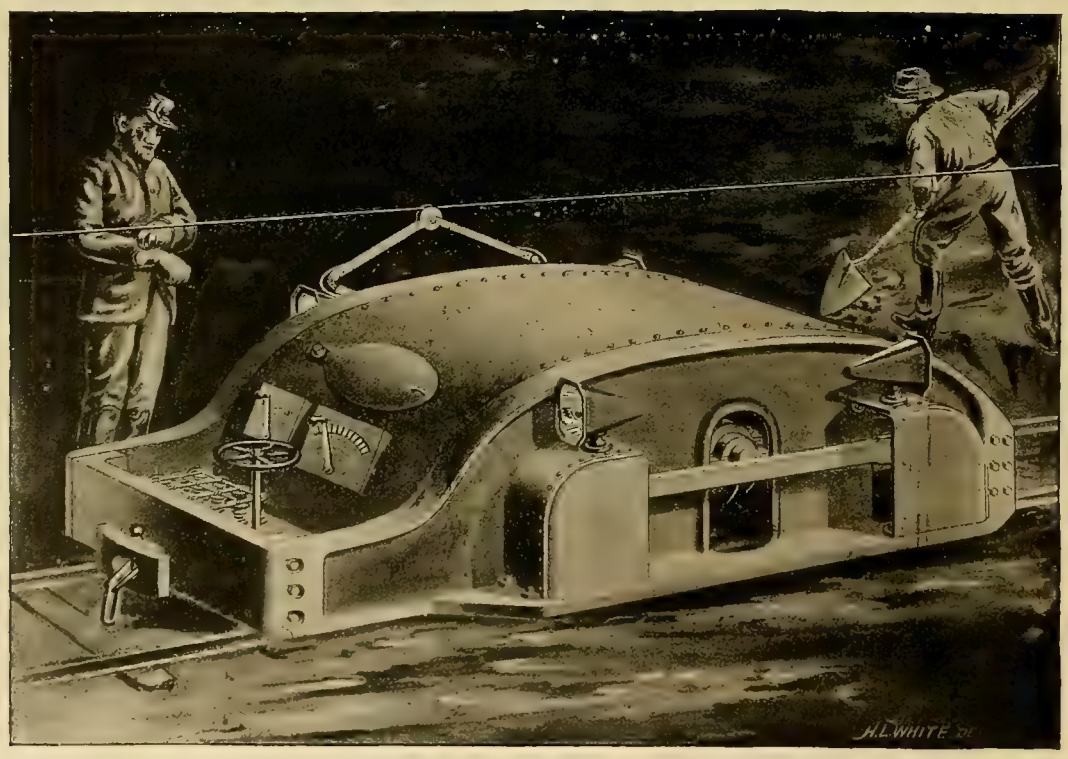

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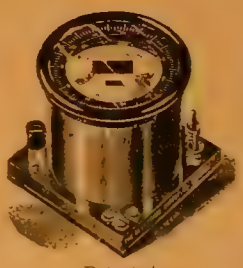
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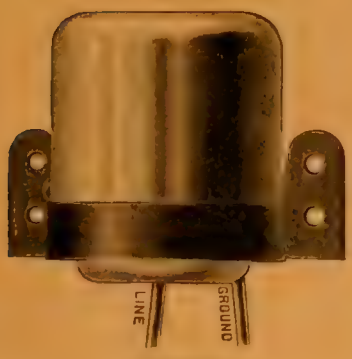

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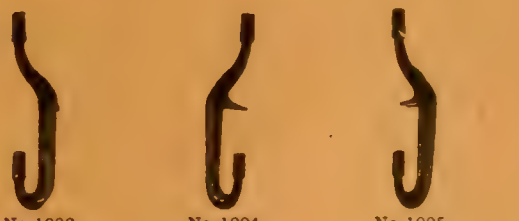
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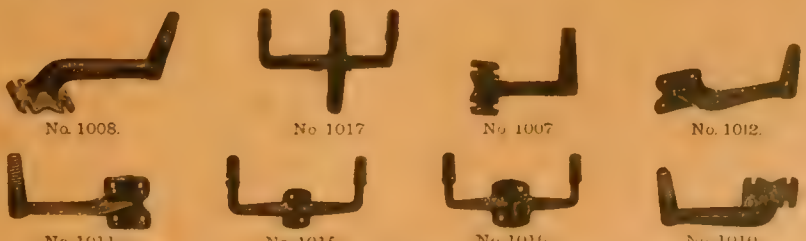
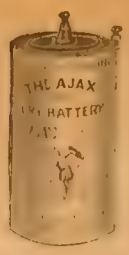

No. 1008. No 1017 No 1007 No. 1012.
No. 1011 No 1015 No 1016 No 1010

(Patented.)
Chase Strain Insulator.



(Patents applied for.)

HIGH INSULATION BRACKETS.

SEE

Catalogue No. 560 for Electric Light and Power Supplies.

SEE

Catalogue No. 648 for District Messenger and Fire Alarm Supplies, Bells, Batteries, Etc.

THE ELECTRICAL SUPPLY CO.

171 RANDOLPH ST.

CHICAGO.

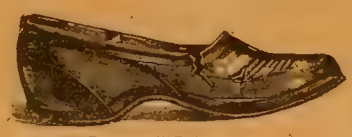
We are particularly desirous, and in fact make a specialty of furnishing large Habirshaw Cores to fulfill unusual and difficult conditions of installation. Of the quality of the Cores furnished, we can assure our customers that they are manufactured in the most scientific and painstaking manner, and that every precaution is taken to guard against every possible difficulty that may arise. Special attention is called to the uniformity and exact dimensions of the large Cores as evidencing the care with which they are manufactured. A large number of the special Cores have been made during the past five years, and that there have been no failures is the strongest confirmation of our claim to superiority. We can aver, without fear of contradiction, that no other manufacturer of heavy rubber Cores, has given equal attention to this branch of his product.

No list prices can be given as the cores are made especially to suit given conditions which radically differ in each case. We shall be pleased to quote prices upon receipt of the special information requested on page 7 of our catalogue No. 732.

See Catalogue No. 732 for further particulars regarding Habirshaw insulation.

The Two Principal Sources of Rubber Supply.

(Pure Para Rubber Stock.)



("Recovered" Rubber Stock.)

It is a fact, though not generally known, that the larger part of manufactured rubber goods is made from so called "recovered rubber," principally from old rubber boots, shoes, rubber hose, rubber springs, packing, etc. Rubber that has been vulcanized is no longer rubber but a chemical compound of sulphur and rubber, and is not capable of being treated or worked as pure rubber. Goods manufactured from "recovered" rubber bear the same relation to goods made from pure rubber that shoddy bears to genuine woolen goods.

The following extracts from a report of analysis and tests on various samples of insulated wire will be of interest in this connection. The authority from which we quote is one well known, and with a reputation second to none. We refer to the samples by letters in preference to using the trade names:

Sample "*A*" shows 15 per cent. of a heavy hydro carbon similar to ozokerite, and assimilating to an article known in Europe as nigrite.

Sample "*B*" has been made over from "recovered" rubber, or a mixture of "recovered" rubber and oxidized oils.

Sample "*C*" shows by analysis very nearly 30 per cent. of adulteration, consisting chiefly of oxidized oils. The process is known as "spurted" or "spewed" insulation. (See note below.)

Sample "*D*." Several samples of this insulation were taken, all of which varied. The composition of the rubber is "way off," being largely made up of a heavy substance similar to white lead. The white layer goes to pieces very rapidly.

Sample "*E*," HABIRSHAW, is the only one of the samples tested, which by analysis shows that pure Para Rubber is the only organic substance used in the insulation.

Sample "*F*" has about 5 per cent. of resin. It is poorly manufactured, the "spurted" process being used.

Sample "*G*" is made and built upon the same plan as "*F*," containing a mixture of resins. This insulation is perhaps the poorest made of any, and shows a very imperfect knowledge of manufacture. The "spurted" process is used.

NOTE. "Spurted" or "spewed" insulation, so far as known, cannot be made of pure rubber compound. The only claim that can be made for it is that it produces an insulation which is seamless, *but this condition is got at the expense of the quality of the insulating material.* On this question of having a seam, there is only one view to be taken: it is stronger than the other, provided the manufacture is carried on correctly; if not it is like all other badly made things, "good for nothing."

And the Result, as Demonstrated by a Single Test.

1. 2. 3. 4.

The accompanying cuts represent the characteristic results of a qualitative test on the composition of 13 samples of so-called rubber wires. This test was made by removing the outer covering of each sample—all braid, paint, etc.—and then paring off the insulating material and putting in a bottle with naphtha. The action of naphtha on "rubber" wire covering is briefly as follows:

1—To swell the rubber without dissolving.

2—By this action to loosen and precipitate mineral impurities and adulterations to some extent

3—To dissolve waxes, ozokerites, oil compounds, etc.

This test, while by no means exhaustive, is more instructive and valuable than any single test that can be applied in the laboratory—far more valuable than insulation tests—and when the final rub, the test of time, cannot be awaited it will serve to show the ridiculous pretensions of the makers of many "Best Rubber Wires."

Our samples, in the test here illustrated at the end of three months, included all the well-known gum insulations in the market (we dislike to say "Rubber") and some not so well known, which are none the worse for that.

Number of samples represented by Figure 1 1
Character, clear liquor, very heavy white mineral deposit. Showing the compound to be heavily adulterated with white lead.

Number of samples represented by Figure 2 8
Character, inky black liquor from dissolved gums, oils or resins, other than rubber.

Number of samples represented by Figure 3 3
Character, black and dirty liquor. Abundant chalky or dirty mineral deposit.

Number of samples represented by Figure 4 1
Contents all kinds of ***HABIRSHAW***.

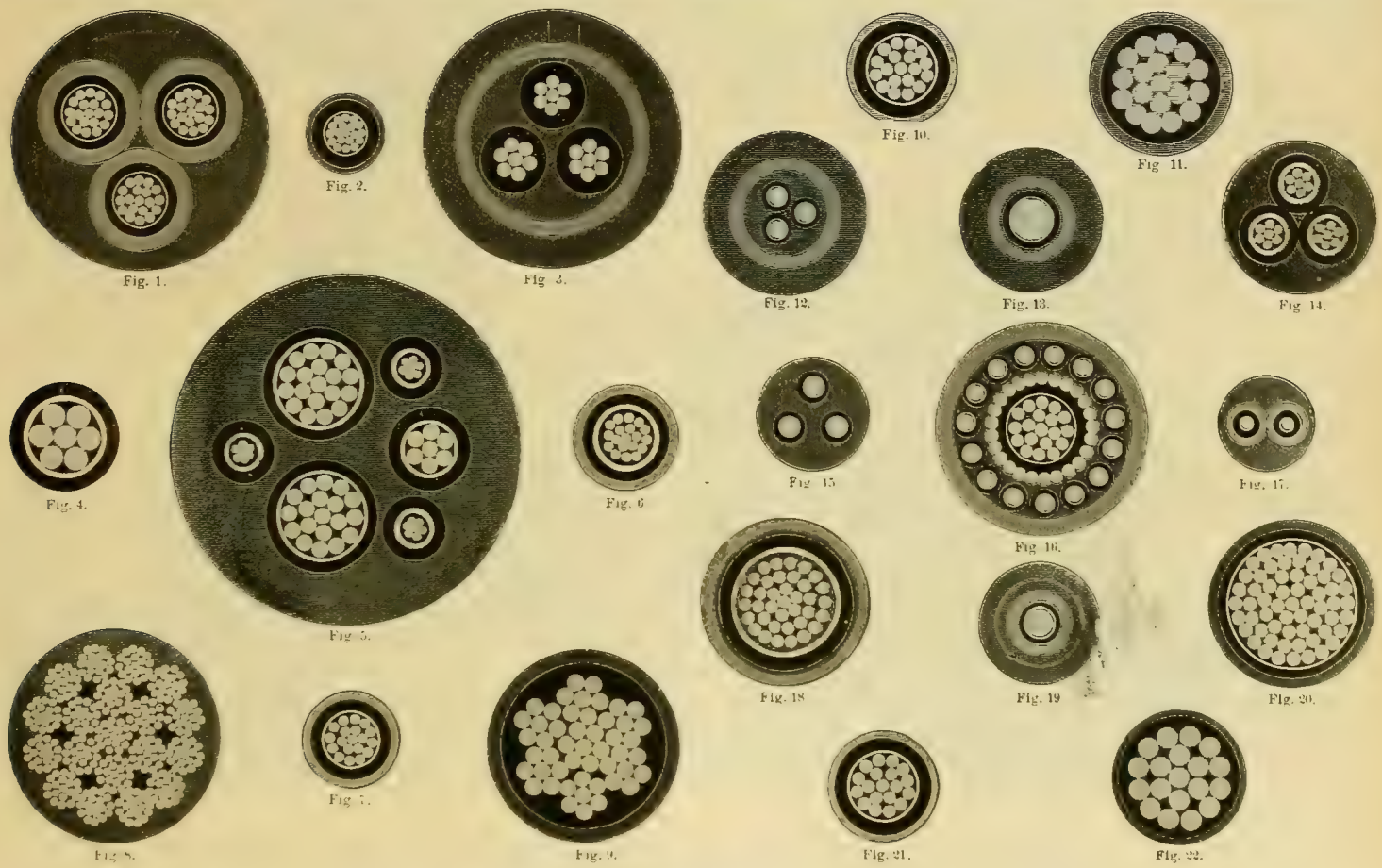
Character, clear liquor showing absence of gums, oils or resins, other than rubber. No deposit, showing absence of dirt or mineral impurity.

Number of samples tested 13

Pure Para Rubber is the only Organic Substance used in the Habirshaw Insulation.

THE ELECTRICAL SUPPLY CO.
171 RANDOLPH ST.
CHICAGO.

SPECIAL HABIRSHAW CORES.



DESCRIPTION.

Figure 1.—Feeder Core. Three circuit. Outside diameter 1 12-16 inches. 120,000 circular mils. Insulated with rubber and leaded.

This class of Cores is furnished from 20,000 to 150,000 circular mils, and is similar to those furnished the Brooklyn Edison Co., Brooklyn, New York, and the Edison Illuminating Co., New York.

Figure 2.—Land Core, leaded. Outside diameter 9-16 inches. Used in the Interior Department, Washington, Brush Incandescent Installation.

Figure 3.—Feeder Core. Three circuit. Outside diameter 1 12-16 inches. 120,000 circular mils.

The construction is similar to Figure 1, with the exception that the lead protection is placed around all three strands together instead of each one separately. This particular Core was used by the Brooklyn Edison Electric Light Company.

Figure 4.—Dynamo Feeders and general service. Outside diameter 12-16 inches. These Cores are made in all sizes.

Figure 5.—For Submarine work. Outside diameter 2 5-16 inches. 450,000 circular mils. This has no lead protection or outside armoring, but instead is covered with jute, which is now largely used in the telegraph service in Europe, and is found to wear better and give better protection. Being more flexible it protects the cable from being broken and pulled apart. This particular Core was used by the Edison Electric Light Co., Easton, Pa., to lay across the Delaware River.

Figure 6.—Marine Core. Outside diameter 12 16 inches Habirshaw insulation, lead covered. This Core is used on all of the Government Cruisers.

Figure 7.—Land Core, leaded. Outside diameter 10-16 inches. Conductor composed of 19 No. 16 B. W. G. Wires.

This particular Core was used in the installation of the Steamer Puritan.

Figure 8.—Feeder Cable. Outside diameter 1 7-16 inches. 700,000 circular mils. Composed of 361 No. 17 B. & S. wires.

This particular Cable was used for ducts in the streets by the Brooklyn Edison Electric Light Co., Brooklyn, New York.

Figure 9.—Feeder Cable. Outside diameter 1 5-16 inches. 500,000 circular mils, Habirshaw insulation.

This style of Feeder Cable was used in the Brooklyn Edison Electric Light Station, New York.

Figure 10.—Feeder Conductor for dry places. Three circuit. Outside diameter 14-16 inches. 120,000 circular mils.

A conductor similar to this was used in the Grand Central Depot Installation, New York.

Figure 11.—Feeder Conductor. Outside diameter 15-16 inches. 300,000 circular mils.

Figure 12.—Underground Core. Three Conductor. Triangular arrangement. Outside diameter 1 2-16 inches. This Core is encased in lead, and is served with an outside protection.

Used for underground work in the New Jersey Central Railway Depot, opposite New York. Edison Installation.

Figure 13.—Underground Core. Outside diameter one inch. Habirshaw Insulation, leaded, and lead protected with an outside serving.

Figure 14.—Portable Cable. Three strands. Nos. 7 and 14 B. & S.

This class of cables is used for stage light, scenery light, and other special service in theatres. The outside serving is flame-proof.

The Cable illustrated was used in the Broadway Theatre, New York. Edison Installation.

Figure 15.—Feeder Cable. Outside diameter 12 16 inches. Habirshaw Insulation. Not leaded.

Figure 16.—Underground Core. Three circuit. Outside diameter 1 7 16 inches 250 000 circular mils. Habirshaw Insulation, lead covered.

Used by the Harrisburg Electric Light Co, Harrisburg, Pa., for underground work. Edison Installation.

Figure 17.—Underground Core. Two circuit. Composed of two No. 16 B. W. G. Wires. Habirshaw Insulation.

This Conductor was used by the Troy Fire Department.

Figure 18.—Naval Core. Lead encased. Outside diameter 1 3-16 inches. 255,000 circular mils.

Core similar to this was used for dynamo leads on all of the new Government Cruisers: San Francisco, Boston, Chicago, Charleston, etc.

Figure 19.—Underground Conductor. Outside diameter 13 16 inches. Habirshaw Insulation, not leaded.

Conductor similar to this was used in the installation of the New Jersey Central Railway Depot, opposite New York.

Figure 20.—Feeder Core. Outside diameter 1 3-16 inches. 420,000 circular mils. Composed of 61 No. 14 B. W. G. Wires.

Used in the installation of the Broadway Theatre, New York City, New York.

Figure 21.—Feeder Conductor. Outside diameter 12-16 inches. Habirshaw Insulation. Outside flame-proof.

Used in the installation of the Mount Morris Electric Light Station, New York.

Figure 22.—Feeder Conductor. Outside diameter 15-16 inches. 250,000 circular mils. This class of goods is furnished from 100,000 to 900,000 circular mils. It is entirely for use in dry places, like well constructed stations. It is also valuable for running through the station, under sidewalks and ducts to the street to make connections. The insulation will answer every purpose for the uses and conditions above mentioned, but it is not intended for underground service.

Our Specialty

MAIN DRIVING

Leather Belts.

1 72-inch, 2-ply Belt } Second order { *Louisiana Electric Light Co., New Orleans, La.*
2 48-inch, 2-ply Belt }

1 54-inch, 3-ply Perforated. *Tacoma Railway & Motor Co., Tacoma, Wash.*

2 30-inch, 3-ply Perforated. { *Gautier Steel Dept.* / *Cambria Iron Co.* } *Johnstown, Pa.*

1 41-inch, 3-ply Electric. *Citizens' Electric Light Co., Brooklyn, N. Y.*

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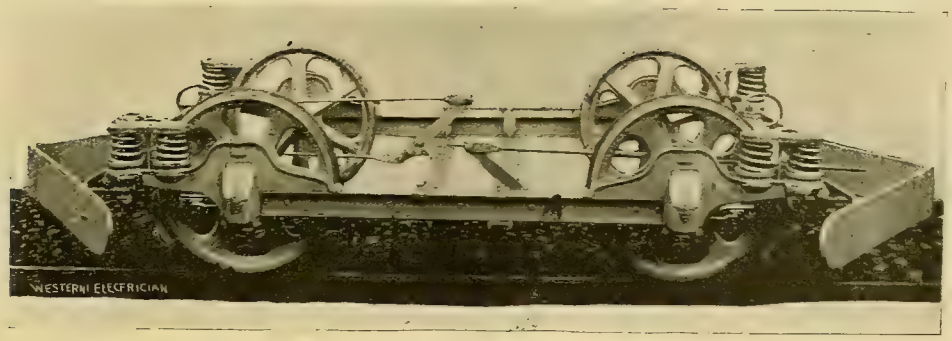
McGUIRE MANUFACTURING COMPANY



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ARC LIGHTING

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FEATURES: Close Regulation.
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Highest Efficiency.

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WILL BE EXHIBITED AT THE

PROVIDENCE CONVENTION

AND THAT'S

GRIMSHAW WHITE CORE WIRE.

ANNUNCIATORS,

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PORCELAIN CUT-OUTS,

Main and Branch Cut-Outs, Rosettes and Switches, Underwriters' Weather Proof Wires and Line Supplies.

Write for Prices on these Specialties Our New Catalogue for 1891 Just Out.

54 & 56 FRANKLIN STREET, CHICAGO.

THE ELECTRICAL SUPPLY CO.
171 RANDOLPH ST.
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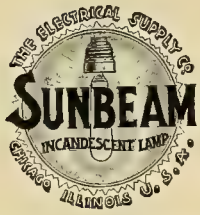
We make a specialty of all Tools and Special Devices for Electric Railway Construction.

We carry a large stock of Magnet Wire, and can fill orders on short notice.

RAILWAY DEPARTMENT.

Combining Greatest Conductivity with Great Tensile Strength.



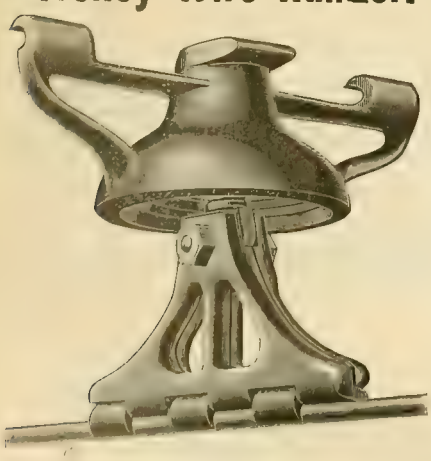
Try "Sunbeam" Light.

We consider the quality of the light furnished to be of first importance.

Habirshaw Insulation should be used for all concealed work and wherever trying conditions are to be encountered.

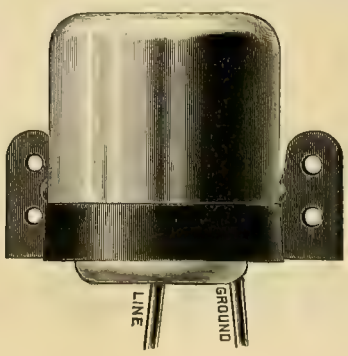
For Incandescent Wiring, For Underground Work,
For all Damp Places, For Pliable Dynamo Cables,
For Flexible Cords.

Trolley Wire Hanger.



Shield Brand Insulation is highly recommended for Feeder Wires.

Wirt Lightning Arrester.



Chase Strain Insulator.

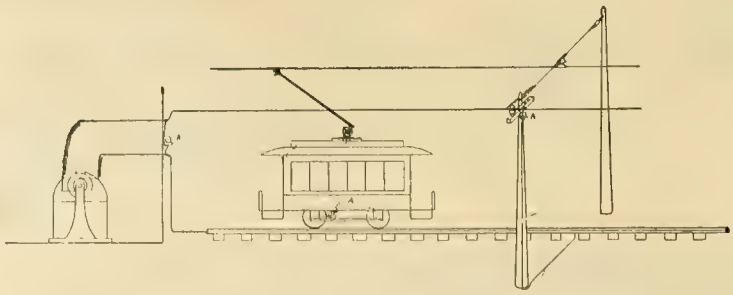


Diagram showing method of connecting Wirt Lightning Arrester on Poles and Cars.

TRADE SUPPLEMENT.

Western Electrician.

TRADE SUPPLEMENT. CHICAGO, FEBRUARY 21, 1891. No. 2

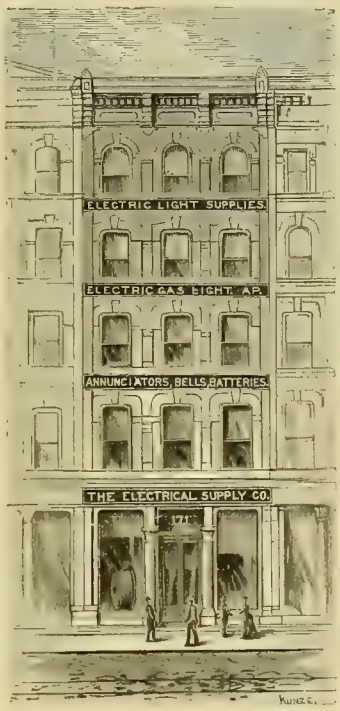
The Electrical Supply Company.

The rapid development of the electrical trade in this country has been the marvel of the age, and the position occupied by the West as compared with other sections of the country gives evidence of its enterprise and business sagacity. It is undoubtedly true that the electrical industries have done more for the West in developing it, and attracting the attention of energetic and enterprising men, and bringing capital to it than any other agency, and it is equally true that electrical industries owe much to this section. It has provided an excellent field for exploiters of electrical enterprises, and its wide-awake towns have seized every opportunity to advance their claims for public favor. The new towns and cities, which during the last ten years have been springing up in different parts of the West, have been certainly boomed. There has been much rivalry both as to population and natural resources of the surrounding country. In localities where water power is available, and the prospect for building up a manufacturing center is promising, electrical enterprises have been particularly favored. It has become a recognized fact in the West that a complete system of arc and incandescent lighting, motor service, street railways, and a telephone exchange are quite as necessary as the "general store" of an Eastern village. Not many years ago small towns in the East considered themselves greatly favored if a telegraph line passed through their corporate limits, and they were given communication with the outside world, but Western push and enterprise have long since passed these landmarks of Eastern conservatism, and nothing short of a thorough equipment of all departments of electrical industries will satisfy the energetic Western investor. The enterprise thus displayed is truly commendable. Many Western cities, it is true, are scarcely more, in point of population, than Eastern villages, yet they have all the conveniences of the larger Eastern cities. There is not a town that does not aim to be a city in a short time, and when hardly out of their swaddling clothes they appropriate to themselves telephone service, electric lighting, and many of them have taken the lead among their older brethren in the introduction of electric street railway service.

This extensive adoption of commercial electricity has, as a natural result, compelled the establishment of electrical supply houses in the large Western commercial centers. The delay occasioned in the earlier days by sending to the Eastern factories for supplies was not in keeping with Western enterprise. As a result, electrical supply companies of more or less magnitude form a chain at present across the continent, and each one, in its endeavor to secure its share of business, has of course increased the competition until the West is the most hotly contested field in this line of business at present in the United States.

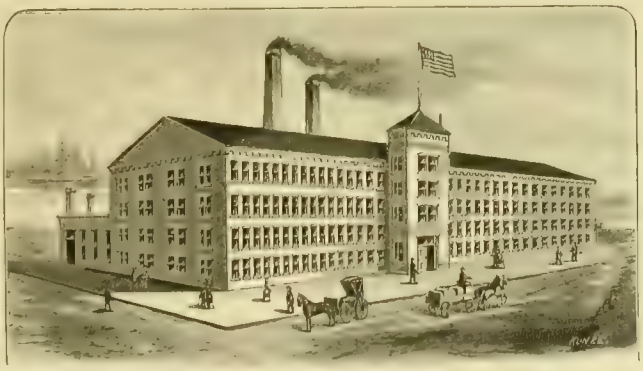
This is especially true of electrical supply companies that make a specialty of furnishing material for electric light and electric railway construction, and these are more particularly the outcome of the past ten years. Previous to that period, for fifteen years perhaps, companies dealing in electrical goods had been in existence, but their articles of merchandise consisted principally of telegraph and battery material, and a little later, of telephone supplies.

Among the largest of the electrical supply houses at present dealing in almost all classes of electrical goods, is the Electrical Supply company of Ansonia and Chicago. This company was organized in 1880, and the intention was at



ELECTRICAL SUPPLY COMPANY—RANDOLPH STREET STORE, CHICAGO.

the time of its inception, to deal mostly in electric light supplies, which were then just about coming into general use, and particularly to manufacture and introduce insulated wires, this company being a pioneer in this branch of the business. In the early days of the Electrical Supply company, then located at Ansonia, Conn., and before it had assumed its present magnitude, the only line wire used was copper wire, double braided and paraffined.



ELECTRICAL SUPPLY COMPANY'S FACTORY AT ANSONIA, CONN.

As will be remembered by many, the line construction prior to 1880 was of a very low grade, and wires would be strung up in the crudest manner possible, often crossing one another in such a way that the insulation would frequently ignite, and the paraffine being inflammable, the fire would run along the wire for several feet. Owing to the occurrence of many of these accidents a fireproof line wire was suggested, and placed upon the market with the sole intention of resisting and obviating conflagration, that being the only qualification that was taken into consideration.

This new departure resulted in the introduction of Underwriters' wire, which at that time was insulated with asbestos paint. As far as is known, none except fire-resisting tests were made, and the necessity for a weather-proof wire, much less a moisture-proof, was not at the time considered. The Electrical Supply company was one of the earliest manufacturers to place upon the market a weather-proof wire. It met with such success in the introduction of this first production that it was encouraged to continue its operations in this direction.

It soon became necessary to increase its facilities for manufacturing weatherproof wire, and so extensive did the business become that important changes and additions to the factory were found necessary. Other wires were from time to time added to their line, and found a ready market on account of their general excellence and the care with which they were made.

Weatherproof wire has now been largely succeeded by moisture-proof wire, as the latter, though more expensive in first cost, has repeatedly proved its economy in the long run. The celebrated Shield Brand Moisture proof wire has now become one of the regularly established specialties of the Electrical Supply company.

As an illustration of the development of the supply business and the close competition of the present day, it may be stated that before the introduction of weatherproof wire as a specialty the company had introduced as its principal specialty the Wallace diamond carbon for arc lamps. The Wallace carbons at that time sold for eighty dollars a thousand, which, as may be inferred, left a fair margin of profit. Some idea of the growth and dissemination of electric lighting may be inferred from the fact, that but ten years ago the Wallace carbons found a ready market at eighty dollars a thousand, while sharp competition is now necessary to introduce arc light carbons at any price.

The company's business has kept pace with the progress of the application of the art to commercial affairs. Its factories at Ansonia, Conn, which are herewith illustrated, have been enlarged several times, and are thoroughly equipped and arranged with excellent judgment. All kinds of electrical devices are manufactured by the company, and a small army of operators are employed.

The establishment of a branch at Chicago was one of the most important steps in the history of the company. Seven years ago F. S. Terry, who, at that time had charge of the office and books of the present company at Ansonia was intrusted with the mission of establishing a Western house. That he has succeeded is shown by the excellent business which he has built up in the West. The company's original warehouse at 175 Lake street, soon became inadequate to the demands of the trade, and the present location, 171 Randolph street, was secured. This building, which is now occupied as salesrooms, offices and storehouse of the company is shown in the accompanying cut. Additional storeroom, however, has recently

been secured. The offices, salesroom and shipping room of the company are on the street floor and present a busy scene. A visitor will find an unusually attractive display of fine testing instruments of modern design and standard make; all kinds of electrical devices in fact are displayed. The storerooms are filled with all kinds of novelties and standard supplies, and an extensive line of wire is always on hand.

The large business which resulted immediately upon the establishment of the Chicago branch in November, 1884, has compelled the addition of many new facilities at the factory at Ansonia.

The methods employed by the Electrical Supply company in caring for orders are unique in conception, and are designed to avoid delay in shipping. To better attain the desired end, the management has within the last few years, gradually evolved a departmentary system, which, besides affording the most expeditious manner of conducting the business, possesses the additional merit of confining each class of goods to its own particular department.

The advantage of this method of office organization is apparent. Each department handles and transacts its business only with those customers and with that class of goods with which it is most familiar, and customers very soon realize the fact that any order they send in receives careful and personal attention from those in charge of the departments.

The growth of electricity in its different branches has necessitated the formation of a department for each line of business, and the electric railway department, the electric light and power department, house goods department, city department, retail department, engineering department, advertising department and accounting department, are now thoroughly organized in such a manner as to dovetail, as it were, into each other in perfect harmony, and with the least possible delay. Each department may be said to be complete in itself, and not dependent in any way upon another, except in such cases as would naturally occur in special instances. At the head of each department is some one with special qualifications or experience in that particular line. Mr. Terry, as manager, assumes personal supervision over the entire establishment. He has been particularly fortunate in the selection of employes, and he has surrounded himself with an excellent corps of assistants. From being a comparatively small concern at the time of its organization, the Electrical Supply company occupies a leading position in the front ranks of supply houses to-day, and while this is, of course, largely due to the unprecedented growth of electrical industries, too much credit cannot be given to the management for the perfect organization which it has attained.

From time to time this company has placed upon the market new articles of merit which have been suggested by the exigencies of the times. It cannot, of course, be said that there have been no failures, for all business concerns learn to their cost that they are many and constant, but with every set-back this company has risen to the occasion with renewed determination to attain the desired success, and the position it occupies to-day amply attests that the coveted position has been gained.

As manufacturers of magnet wire the Electrical Supply company is one of the most extensive in the country, and constantly supplies the largest manufacturing companies with a large part of what they use of this class of wire. The sale of the Shield brand moisture-proof line wire has increased monthly since it was first placed upon the market, and customers are now confident that it is all that its manufacturers claim.

The factories at Ansonia, Conn., are constantly engaged in experimenting in the line of compound insulations, and the careful study that is devoted to this branch of the business is bearing fruit in the high quality of line wire made.

Within the last year this company, which is constantly on the alert in the endeavor to keep ahead of the times, has secured the sole Western agency for the celebrated Habirshaw rubber covered wires, cables and cores. In this the Electrical Supply company made a valuable acquisition to their already extensive line of general supplies. The Habirshaw wires are the production of only the purest para rubber, combined with the most perfect machinery and appliances ever adapted for insulating purposes. The claim is frequently made that one rubber wire is as good as another, but this claim is unsubstantiated by direct proof. A large part of the so-called rubber wires find their genesis in discarded rubber boots, leaky hose and pickings of the scrap heap. The manufacturers of Habirshaw wire take pride in the fact that only the purest of rubber is used in the insulation of this wire. The matter of profit does not absorb the entire attention of the company; on the contrary, the first thought is the quality of the goods turned out from the factory. The electrical fraternity is now becoming thoroughly satisfied of this fact.

The specifications issued by the navy department of the United States government are exceptionally severe and stringent, and in the isolated plants installed on its marine service during the past few years, Habirshaw has been almost entirely adopted, by reason of its high insulating qualities as compared with other rubber wires submitted to government tests. The company carries a very large stock of Habirshaw wire at all times, and for all ordinary sizes can fill orders on demand.

The Electrical Supply company, with its usual far-sightedness, has seen the possibilities that lie within the province of incandescent electric lighting, and the strides which this branch of the business will make in the near future. With this end in view it has secured the exclusive right for the sale of the Sunbeam incandescent lamp. This lamp is one of the many that has made its appearance in the electrical field in the last year, but merits more than a passing notice by reason of its desirability both on account of its brilliance and economy. The Sunbeam lamp factory is located in the West, right in the midst of competing concerns, and must place its output in a field which is far from fallow so far as incandescent lamps go.

The particular characteristics of the Sunbeam, however, have placed it in the front ranks of incandescent lamps, and electric lighting companies are rapidly coming to the conclusion that first cost is not the only factor in the purchase of lamps, but that other considerations enter so largely into purchases of this character that what may be apparently the most expensive at first is really the most economical in the end. The cost of current for the supply of lamps amounts to many times their first cost, and the lamp that gives the most light for a fixed expenditure in current is of more value than a lamp that costs less in the beginning without giving adequate compensation in light.

Realizing the growth that will attend the electric railway work during the coming years, and foreseeing that this department will rapidly forge to the front, the company have equipped their electric railway department with all the facilities necessary for the transaction of this particular branch of the business, and have added to its line of electric railway supplies all the latest improvements which have been patented and placed upon the market up to date.

Among the principal of this class of their supplies may be mentioned the Hercules trolley wire. This wire, by its special process of manfacture, is specially adapted for carrying heavy currents. This wire is electrically welded and can be made in any required continuous length.

Although the electric railway department has been organized but a short time, large orders for supplies have already been booked, and Hercules trolley wire is already well and favorably known among roads already constructing or those expecting to begin operations in the early spring.

The Electrical Supply company is also devoting a great deal of time and attention to perfecting the line of goods designed for domestic electricity, such as bells, batteries, annunciators, burglar alarms, etc. From the constant complaints that have been received from those unaccustomed to charging and caring for ordinary solution batteries, it was led to believe that a dry battery suitably prepared to meet the necessary conditions, would find a ready market. Acting upon this impression the company manufactured and introduced to the public some months ago a dry battery that has since become well known among all the electrical companies in every part of the United States—the Ajax dry battery. This particular form has been subjected at various times to severe tests of efficiency by those who have professed themselves skeptical as to the lasting qualities of a dry cell. In all cases where it has been given a comparative test with other so-called dry batteries at present upon the market, it has sustained its reputation for strength of current, long life and rapid recuperation, to a most marked degree. It is claimed that three cells of the Ajax have closed, by means of clockwork, an electrical circuit for three seconds every five minutes for a period of time now covering nine months, and that at present the Ajax cells are in apparently as good condition as when placed on the circuit. They have also been used of late by lecturers to illustrate electrolytic principles, and have been put to the severe test of operating small incandescent lamps for illustrative purposes.

This company has also lately added to its line the Midget storage battery, which, from all present indications, is destined to become extremely popular and enjoy a large sale. The Midget storage battery is a small secondary cell possessing an e. m. f. of about 2 1-5 volts, and, although a 20-ampere-hour cell, it will on short circuit discharge instantaneously about 75 amperes.

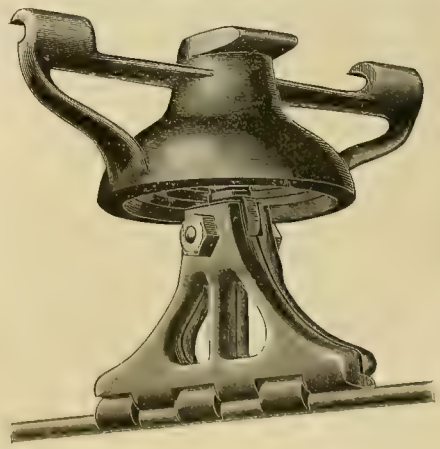
The Midget battery is put up in batteries composed of two, three and four cells, either in polished oak cases, or simply with the glass jar, as may be desired. One cell will operate a physician's cautery or dental lamp very satisfactorily, and four cells can be used advantageously on 1-12 and ⅛-horse power motors.

The Midget battery is the smallest and lowest priced storage cell at present made, and already a large demand has been created among those who desire this type of cell, and yet, for various reasons, find it impracticable to purchase larger and more expensive batteries.

The Electrical Supply company have reason to congratulate themselves upon the quality of the specialties they handle, and also upon the appreciation in which they are held by the electrical public, and the resultant increasing sales.

Trolley Wire Hanger.

The accompanying cut illustrates a trolley wire hanger in which the wire is held by a purely mechanical device, and can be freed and firmly reclasped in a moment's time. The bother of soldering is thus avoided and it is possible to keep hangers in the vertical position and the lines "ship shape" at very small cost of time. As will be seen in the cut, the holding



TROLLEY WIRE HANGER.

clamp is of the simplest pattern. By tightening the bolt at the top of the clamp the wire is strongly held, while by loosening it the wire is instantly released. For the rest, the hanger is a strong and thoroughly made device. The insulating medium, vulcanized rubber, is protected by a metallic shell which extends somewhat beyond the rubber, and acts as an insulator skirt. The principle upon which the hanger is attached to the span wire is one now in great favor. It offers ease and rapidity of application, while the tension of the wire keeps the hanger firmly in place. The Electrical Supply company of Chicago, has placed this device upon the market.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive, and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

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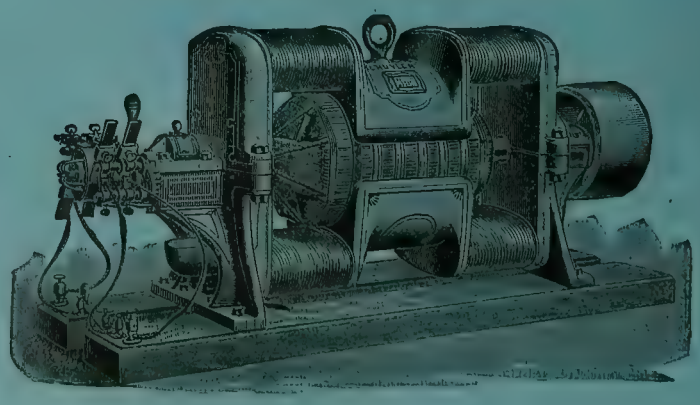

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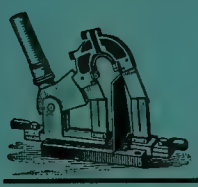

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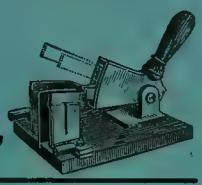

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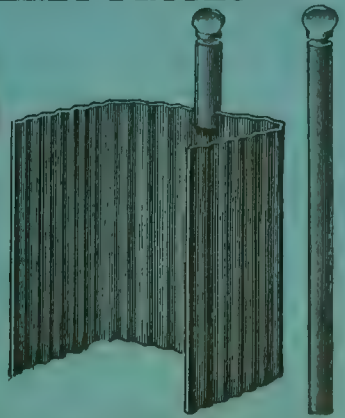

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		Number.	Percentage to total of all Systems.
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Mississippi, - - - -	605	320	$52\frac{4}{5}$ per cent.
Minnesota, - - - -	1781	1579	$88\frac{3}{5}$ per cent.

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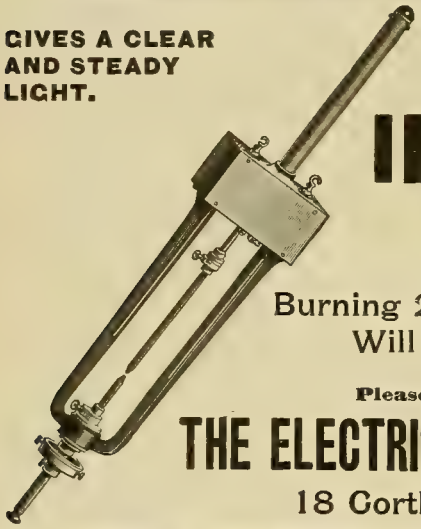

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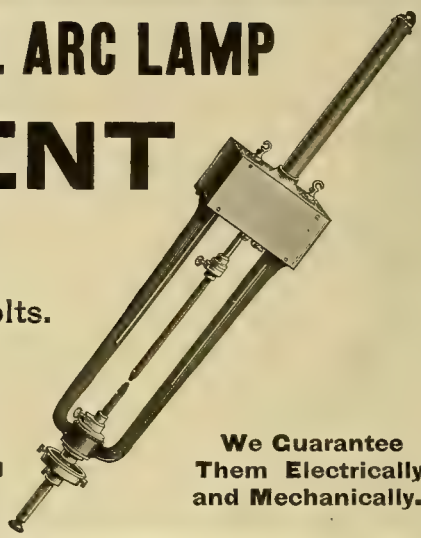

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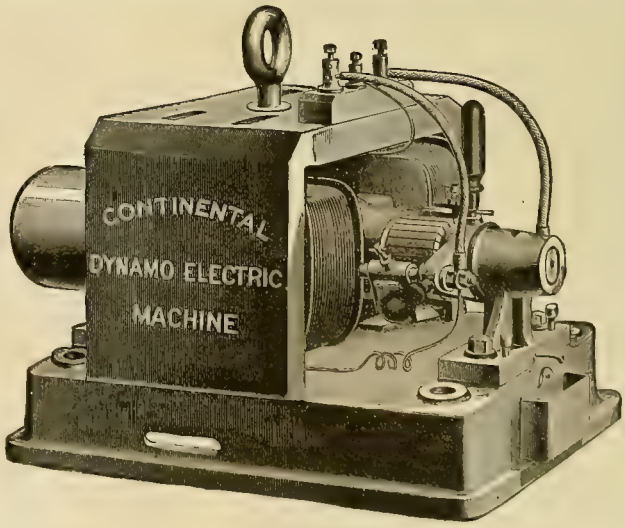

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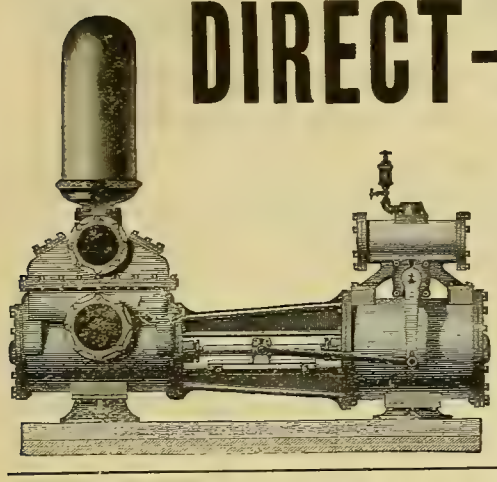

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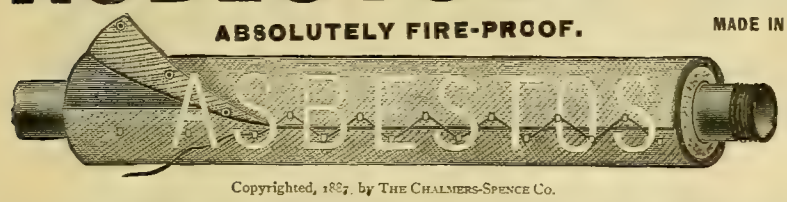

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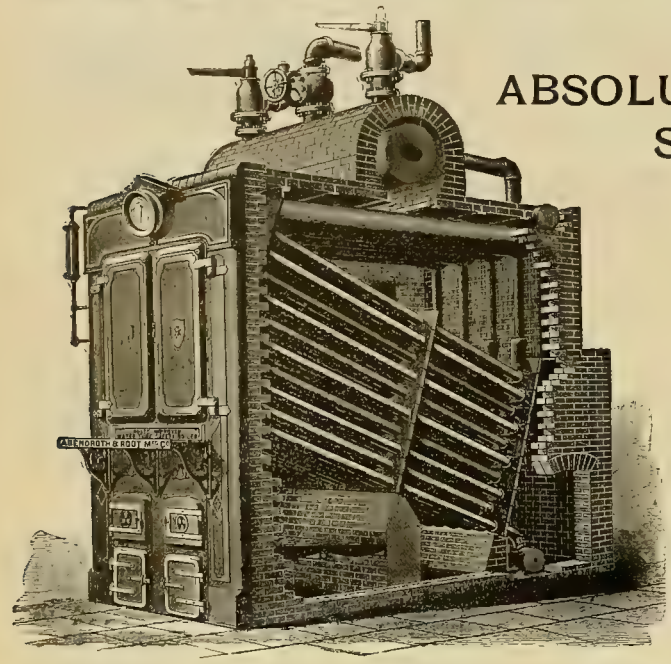

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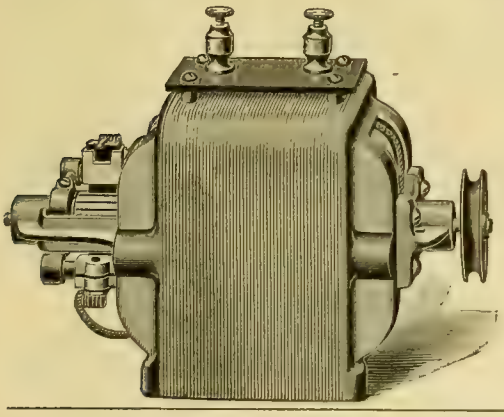

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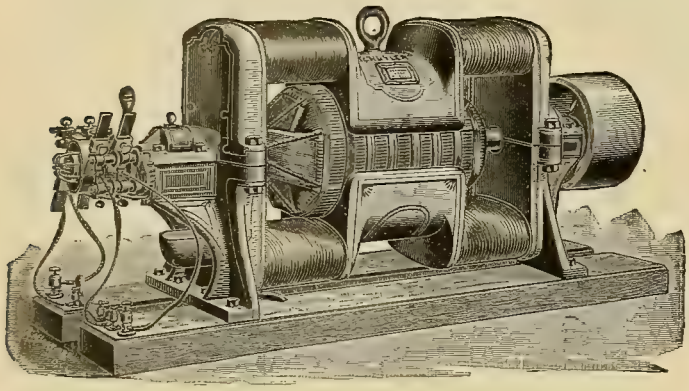

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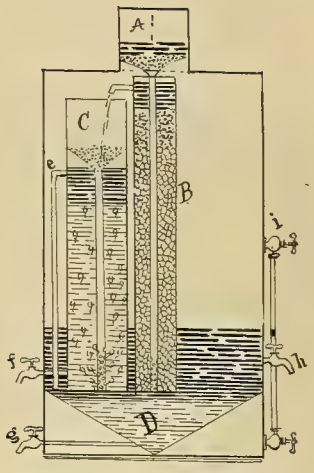

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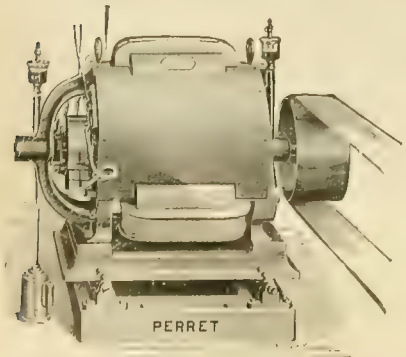

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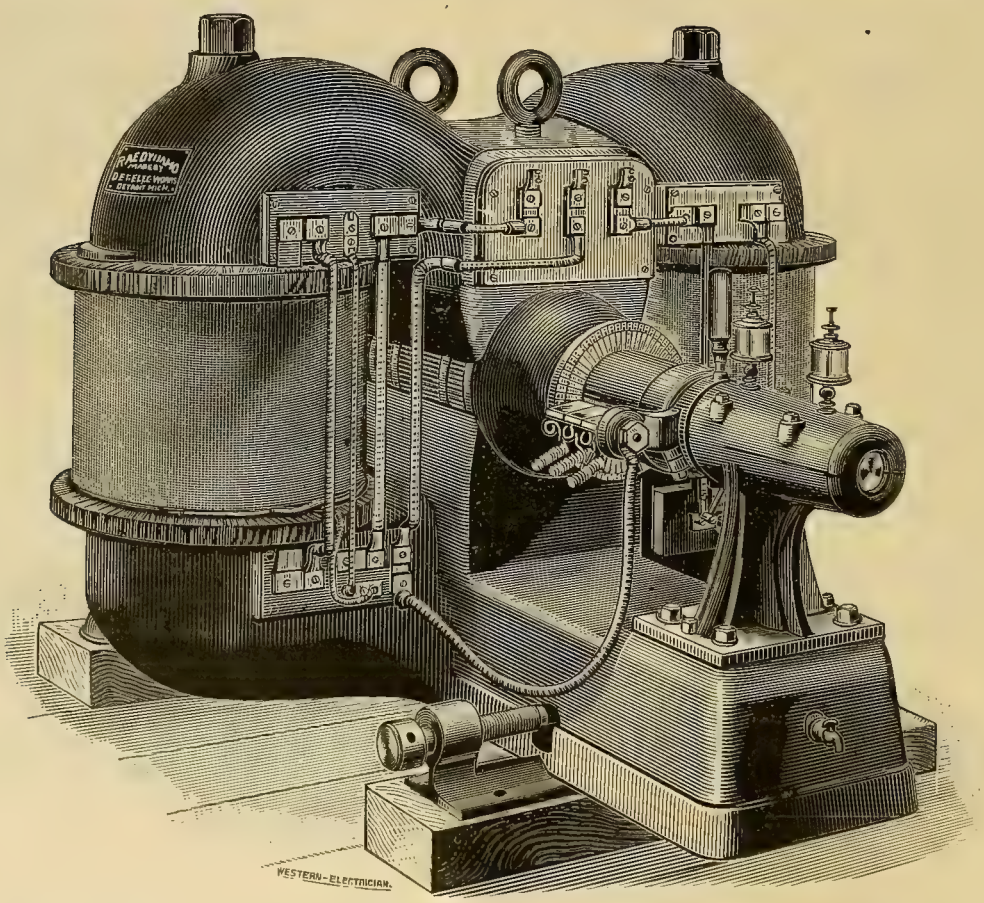


New Standard Compound Wound 80,000 Watt Generator.

Long Distance Power Transmission. Electric Power Plants and Motors.

SEND US DATA AND ESTIMATES WILL BE PROMPTLY FURNISHED.

WORKS, Cor. Woodward and Baltimore Avenues, **DETROIT, MICH.**

THE ELECTRICAL SUPPLY CO.
171 RANDOLPH ST.
CHICAGO.

OUR STRONG POINTS.

In calling the attention of all interested in the purchase of Electrical Supplies to our strong points, we feel that we can do so without apology, and without overstepping the bounds of that native modesty we have long been credited with possessing, inasmuch as

THE BUYER

is always interested in knowing the ability of the seller to offer him advantages.

THE "MANUFACTURING" POINT.

We are manufacturers of Wires, Cables, Cords, Test Instruments and a very large line of general electrical goods; and therefore, by buying from us you escape the middleman's profit.

THE "CUSTOMERS' INTERESTS" POINT.

Our business does not conflict with our customers' interests in any way, shape or manner. We do not manufacture or sell dynamos or motors. We do no construction work. We never meet our customers in competition. Our whole time and attention is given to studying the best manner of manufacturing and filling the wants of the electrical world with reliable goods at moderate prices.

THE "STOCK ON HAND" POINT.

We constantly carry a very large and very well assorted stock of electrical goods and invite all interested to call at our warehouse and inspect the advantages we have to offer in this direction. Without exception and without doubt we carry the largest and best assorted stock of electrical supplies to be found in this or any other country.

THE "COMPLETE ORGANIZATION" POINT.

Our staff is large but well organized. We have many departments at our factories, each department being under the special charge of some one experienced and skilled in the manufacture of the special goods handled by his department.

Our customers are most interested in our

SELLING DEPARTMENTS

which are as follows:

DEPT. NO. 1.

Devoted to the interests of Dealers and Manufacturers, and making a specialty of manufacturing to order.

DEPT. NO. 2.

Devoted to the interests of Electric Light and Power Plants, and making a specialty of Shield Brand Moisture-proof Line Wire, Habirshaw Rubber Covered Wires and Cables, Sunbeam Incandescent Lamps and many other articles of merit too numerous to mention here.

DEPT. NO. 3.

Devoted to the interests of Electric Railway Companies, and making a specialty of assisting in causing the mule to go; also paying some attention to Hercules Trolley Wire, Shield Brand Feeder Wire and numerous new and special devices for construction work.

DEPT. NO. 4.

Devoted to the special interests of all in need of Bells, Batteries, Annunciators, Burglar Alarms, District Call Boxes, Telephone or Telegraph Wires, or Cables, District Call Boxes, Telegraph Instruments, School Supplies and making a specialty of introducing the Ajax Dry Battery to a long suffering and oft forgiving generation.

THE "COMPLETE CATALOGUES" POINT.

For the convenience of our customers and the electrical fraternity, we issue from time to time illustrated catalogues describing our stock as it exists at time of publication. We also issue supplements and circulars describing new articles of merit—our constant aim being to inform our friends at earliest possible moment of any new invention or discovery in which we think they are or should be interested. The many complimentary letters we are constantly receiving from the electrical public bear evidence to the fact that our catalogues and circulars fill "long felt wants," and are appreciated.

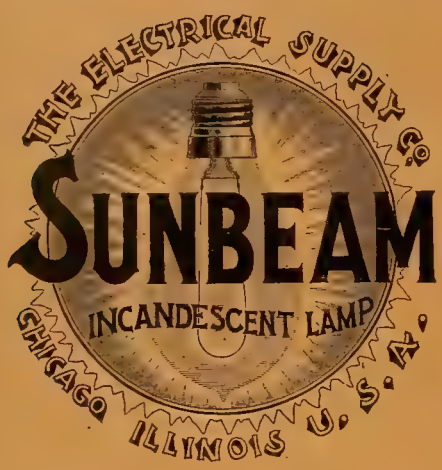
THE "MAIN" POINT

With us always is to merit a continuance of your favors.

THE ELECTRICAL SUPPLY CO.

171 RANDOLPH ST.

CHICAGO.



THE SUNBEAM

INCANDESCENT LAMP.

The lamp that returns most light for a dollar expended in current.

The MOST EXPENSIVE lamp to make.

The LEAST EXPENSIVE lamp to operate.

The lamp that produces a good white light, and is therefore least INJURIOUS to the eye.

Dynamo manufacturers cannot afford to risk the reputation of their machines by using inferior lamps.

Owners of Lighting Stations cannot afford to waste current and handicap their success by using inferior lamps that do not give a satisfactory light.

The public cannot afford to injure their eyesight, and WILL NOT be satisfied with poor lamps when they know "Sunbeam" light can be procured.

SHIELD BRAND

Moisture-Proof Line Wire

For Overhead Lighting Circuits.

For Feeder Wires.

For Power Circuits.

SPECIALLY RECOMMENDED FOR CITY USE.

Tested and approved by Authorities in our largest cities.

BUY THE BEST.

Large Stock constantly carried.

Special facilities for manufacturing largest orders on short notice.

CENTRAL ELECTRIC CO.,

116 & 118 FRANKLIN STREET, CHICAGO.

Connected by Private Wire with Postal-Telegraph Cable System.

OKONITE

TRADE MARK.

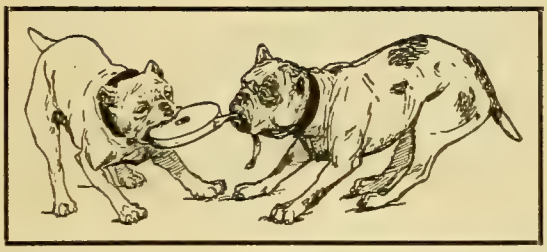
GENERAL WESTERN AGENTS

FOR

Okonite and Improved Candee Wires

AND ALL THE PRODUCTS OF THE OKONITE COMPANY.

MANSON



TAPE

Is the strongest, cleanest, and most lasting of all insulating tapes.

The Bain Break Insulator.

This insulator is universally commended by Railroad men as the most practical and thorough span wire insulator yet brought to their notice.

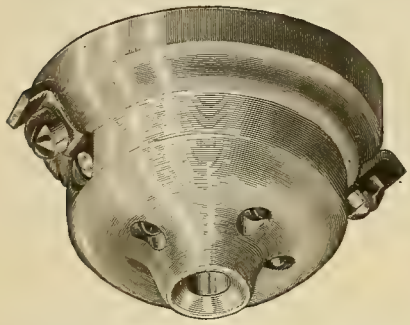
We have a full line all kinds of ***ELECTRICAL SUPPLIES,*** *and have been preparing during the dull months for the spring trade.*

SEND FOR OUR NEW CATALOGUE.

CENTRAL ELECTRIC CO.,

116 & 118 Franklin Street, CHICAGO.

E-L-E-C-T-R-I-X!



"WHAT ARE WE HERE FOR?"

TO SUPPLY ABSOLUTELY ALL THE

Electrical Specialties used on Earth.

WE ARE MAKING DEALS THAT SELL THE STUFF.
YOU WILL BE "IN IT" IF YOU SEND YOUR ORDERS NOW.

Key and Keyless Sockets, Cut-outs, Single and Double Pole Switches, Gas Attachments, Etc., Etc.

The STAR ELECTRIX COMPANY,
1320 Wallace Street, PHILADELPHIA, PA.

AGENCIES: STANDARD ELECTRIC SUPPLY CO., Boston, Mass. W. H. GORDON & CO., 115 Broadway, New York. ILL. ELECTRIC MATERIAL CO., Rookery Building, Chicago.

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Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.

ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.

STORAGE BATTERIES.

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AGENCIES, 926 Drexel Bldg., Philadelphia; 456 Rookery Bldg., Chicago. 111 Water St., Pittsburgh, Pa.

FACTORY: JERSEY CITY, N. J.

WHAT AN EMINENT PHYSICIST SAYS OF THE AXO BATTERY.

UNIVERSITY OF MICHIGAN.

Physics and Electric Engineering.

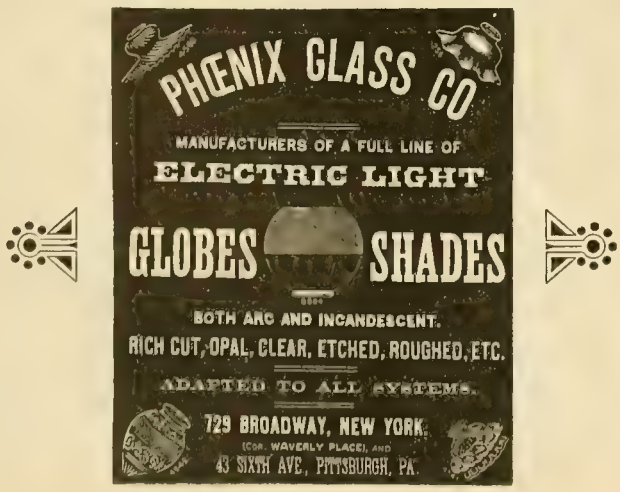
ANN ARBOR, January 7, 1891.

THE LECLANCHE BATTERY CO., New York.

GENTLEMEN:—The two cells of the Axo pattern of your battery, sent me for trial a long time ago have proved to be a most excellent type of cell. One of them I have used for two years and more to furnish the main current in the Rayleigh method of comparing E. M. F. of my standard cells, and it is still in use for the same purpose. The E. M. F. falls to be sure, but only very slowly indeed. *It is now 1.52 true volts after 2 years' service, and the cell has never had a drop of liquid added to it since it was first set up.*

Since your two cells were put into service I have employed a systematic plan of testing, and I can testify to the excellent qualities of the Axo battery from the tests made. Very truly yours,

H. S. CARHART.



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MANAGER
MONITOR ELECTRIC CO.,
149 WABASH AVE., CHICAGO, ILL.
WHOLESALE DEALER IN GENERAL
ELECTRICAL SUPPLIES.
WESTERN AGENT FOR
ALFRED F. MOORE
(ESTABLISHED 1870.)
ELECTRICAL WIRES AND CABLES.
Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

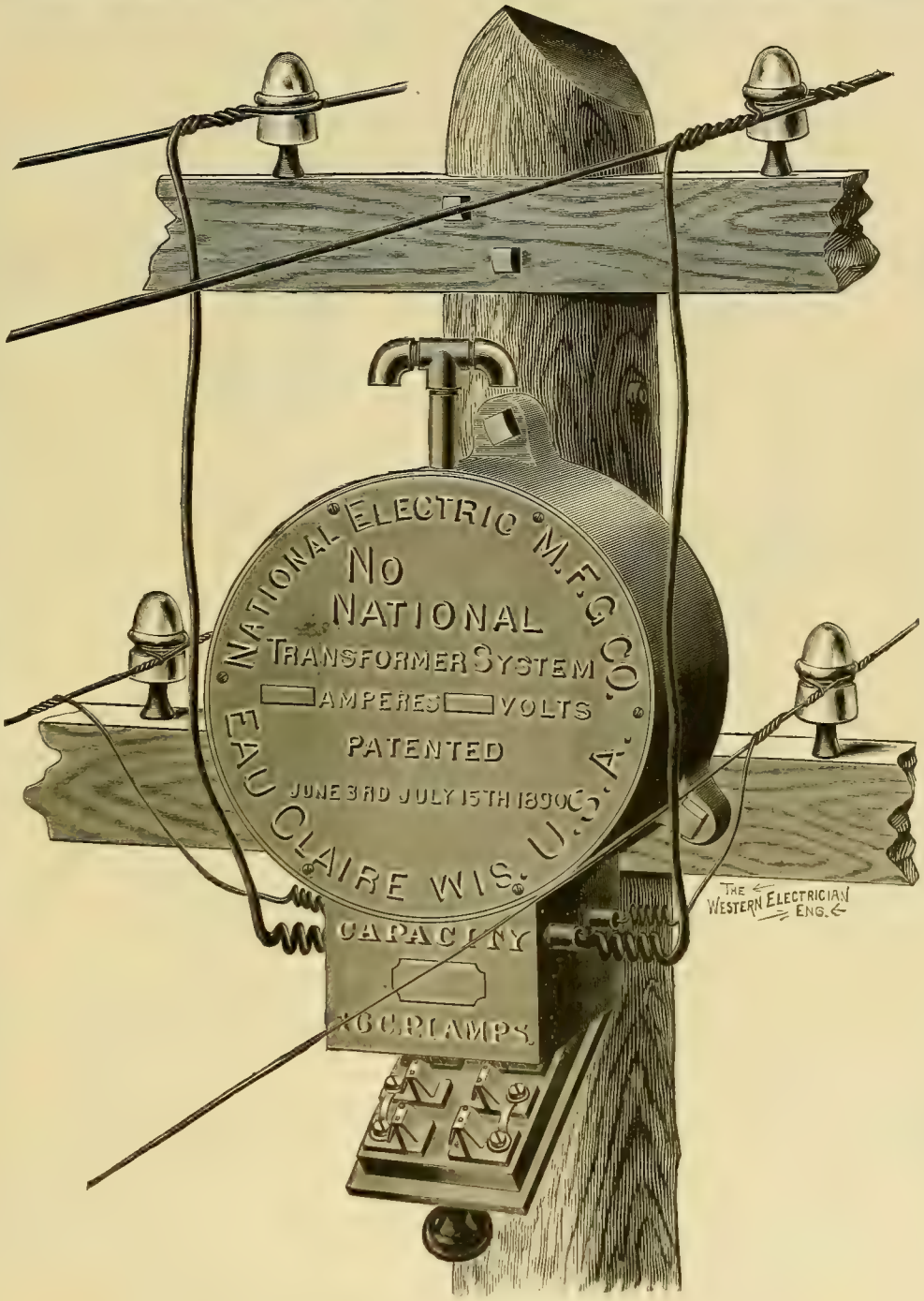
THE NATIONAL TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.

CONVERTER EFFICIENCIES.

It will PAY YOU to throw out your present transformers and substitute OUR MAKE.

No more Accidents from Grounded Circuits.



No more Burnt Fingers or Melted Screw Drivers.

They are the most efficient, {95.2%.} They are absolutely safe. Their regulation is practically perfect.

Transformer on Pole Showing National Safety Fuse Box.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND
PROTECT OUR CUSTOMERS.

COMPLETE
DIRECT CURRENT SYSTEM
—FOR—
ISOLATED LIGHTING.

NATIONAL ELECTRIC MFG. CO., EAU CLAIRE, WIS.

GEO. B. SHAW, Gen'l Manager.

AGENTS:

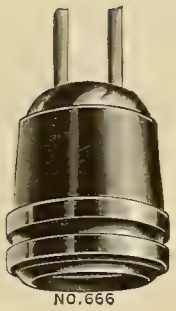
NEW YORK, N. Y.,	National Electric Mfg. & Const. Co., 50 Broadway.
BUFFALO, N. Y.,	Little, McDonald & Co., 141 East Seneca St.
CINCINNATI, O.,	W. N. Gray, 12 Chamber of Commerce.
WASHINGTON, D. C.,	L. N. Cox, 16 Fifth St., S. E.
PHILADELPHIA, PA.,	C. M. Blanchard, Girard Building.
SAN FRANCISCO, CAL.,	National Electric Development Co.
KANSAS CITY, MO.,	Thomas Wolfe, 515 Main St.
ST. PAUL, MINN.,	The Electrical Engineering & Supply Co.
DETROIT, MICH.,	Commercial Electric Co.
DENVER, COLO.,	The Mountain Electric Co.
WINNIPEG, MAN.,	Simpson-Davis Electrical Construction Co.

EDISON GENERAL ELECTRIC CO.,

Edison Building, Broad Street,

NEW YORK.

STANDARD SOCKETS.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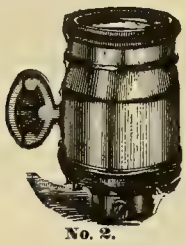
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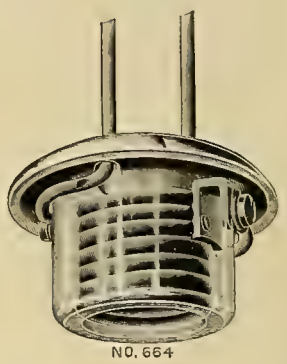
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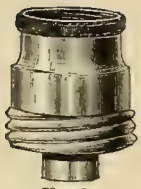
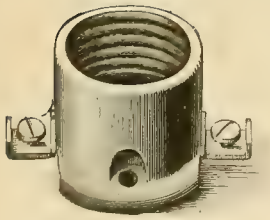
PRICES.


No. 6.

Cat. No.	DESCRIPTION.		Price.	Price to Purchaser, 45% off List.
1	Standard Keyless Socket	Plain	$0.45	$0.247
1	" " "	Polished Brass	.50	.275
2	" Key "	Plain	.75	.412
2	" " "	Polished Brass	.80	.44
2½	" Push-button Socket	Plain	.75	.412
2½	" " " "	Polished Brass	.80	.44
3	" Keyless Receptacle on Wood or Porcelain Base	Plain	.40	.22
		Polished Brass	.45	.247
7	Standard Key Receptacle on Wood or Porcelain Base	Plain	.73	.401
		Polished Brass	.77	.423
6	Standard Keyless Socket	Plain	.50	.275
6	" " "	Polished Brass	.55	.302
3½	Fancy Keyless Receptacle with Wooden Base	Plain Brass	.45	.247
		Polished Brass	.50	.275
3½	Fancy Keyless Receptable fancy Porcelain Base	Plain Brass	.50	.275
		Polished Brass	.54	.297
8	Fancy Keyless Receptacle with Wooden Base	Plain	.85	.467
		Polished Brass	.90	.495
8	Fancy Keyless Receptacle with Porcelain Base	Plain	.90	.495
		Polished Brass	.94	.517
369	Wood "Testing Socket," with Outside Screw Connections		.40	.22
667	Improved Porcelain Waterproof Socket with Rubber Ring		.75	.412
664	Waterproof Glass Socket (Patented)		.75	.412
666	Improved Waterproof Hard Rubber Socket with 10 inches Rubber covered Wire		.75	.412

No. 2½.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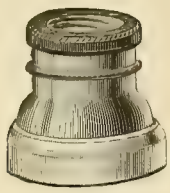
No. 667.

No. 3½.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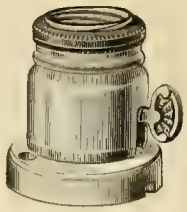
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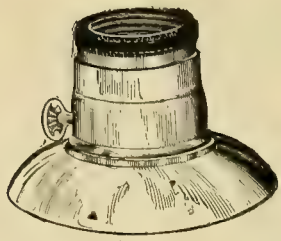

No. 8.

MAIN DISTRICT OFFICES:

Canadian District, Bank of Commerce Bldg., Toronto, Can.
Central District, Rialto Building, Chicago, Ill.
Eastern District, Edison Building, Broad St., New York.
New England District, 38 Pearl Street, Boston, Mass.
Pacific Coast Dist., Edison Bldg., 112 Bush St., San Francisco, Cal.
Pacific Northwest District, Fleischner Bldg., Portland, Ore.
Rocky Mountain District, Masonic Building, Denver, Colo.
Southern District, 10 Decatur Street, Atlanta, Ga.

THE STANDARD VOLTMETER.

THE STANDARD AMMETER.

Weston's Portable Direct-Reading Voltmeter.

Weston's Portable Direct-Reading Ammeters and Mil-Ammeters

FOR DIRECT CURRENT CIRCUITS.

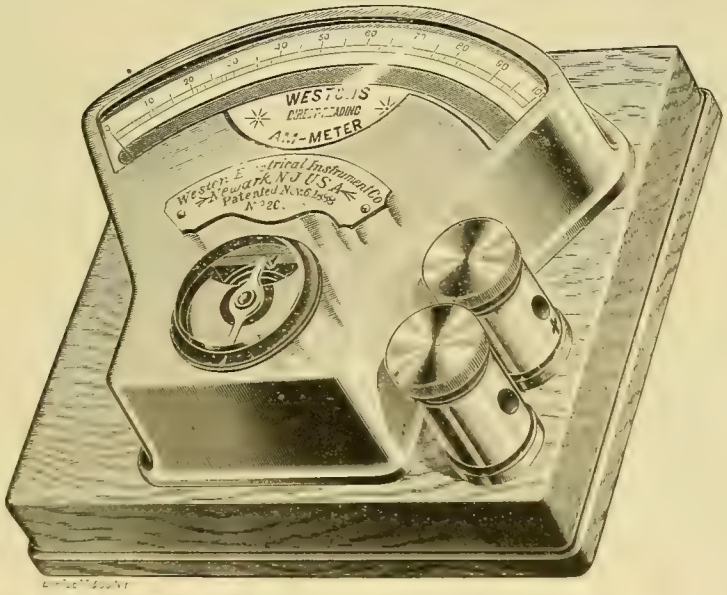
THE WESTON

Standard Voltmeters

— ARE THE —

Best and Most Accurate Portable Instruments Made.

They are perfectly dead beat.
They are direct reading.
They are extremely sensitive, and will indicate to one part in one thousand.



THE WHOLE SCALE

—IS—

AVAILABLE,

— AND —

Accurately Laid Out

—BY—

ACTUAL CALIBRATION.

They have a very high resistance, a matter of great importance.

They are practically **free from temperature error**, the actual difference in their readings being less than **1-4 of 1 per cent.** for 35 degrees, Fahrenheit.

They have no magnetic "lag" and are consequently free from errors arising therefrom.

The temperature error of most of the well-known forms of Voltmeters on the market is about 1 per cent. for 5 degrees Fahrenheit, or 7 per cent. for 35 degrees. The temperature error of such instruments is therefore more than 28 times that of the Weston.

The error from magnetic "lag" of many of the well-known forms of Voltmeters is very high. It varies from 1½ to as much as 14 per cent. The combined errors of such instruments frequently amounts to 15 per cent. when used under ordinary conditions. Such instruments may be "cheap," but it is poor economy to buy them.

The friction errors in many forms of instruments are also quite large, and frequently amount to several per cent.

We have tried to overcome these difficulties and to produce a first-class instrument, as perfect in every mechanical and electrical detail as possible, and at a reasonable price, in view of the quality of the instruments.

Over three years' constant use of our instruments proves beyond a doubt that we have succeeded, and that our instruments are perfectly permanent if used with moderate care.

They have been adopted as standards by many prominent electrical companies in this country. They have also been highly indorsed by the **best electricians and electrical engineers** in this country, and by many of the **most prominent electricians** in Europe.

We make 25 different styles, varying in their ranges from $\frac{1}{100000}$ of a volt to 6,000 volts.

The Weston Standard Ammeters and MIL-AMMETERS

possess many of the excellent features of the Voltmeters. We make at present 14 different styles, with ranges varying from $\frac{1}{10000}$ of an ampere to 150 amperes. We shall presently be in a position to deliver higher range instruments up to 30,000 amperes.

Our facilities for repairing and standardizing electrical instruments are excellent, and we are prepared to do such work at reasonable rates.

Weston Electrical Instrument Co.,

OFFICE AND FACTORY,

114 and 116 William St., NEWARK, N. J.

CORRESPONDENCE SOLICITED.

OBSERVE THE TRADE·MARK·

INSULATED WIRES AND CABLES.

aeriel, submarine and underground.

for TELEPHONE, TELEGRAPH, ELECTRIC LIGHT AND POWER USE.

The OKONITE wires are endorsed and recommended by the most eminent Electrical, Civil and Mining Engineers of the United States and Foreign Countries, and stand unrivalled for their high insulating qualities, durability and extreme toughness.

for INSIDE WIRING OF BUILDINGS and General Railroad and Mining Purposes.

THEY HAVE NO EQUAL.

CANDEE AERIAL WIRES.
MANSON PROTECTING TAPE.
OKONITE TAPE.

Manufactured solely in the UNITED STATES AND EUROPE.

By the INTERNATIONAL OKONITE COMPANY, LIMITED.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers.
F. CAZENOVE JONES, Manager of Factories.

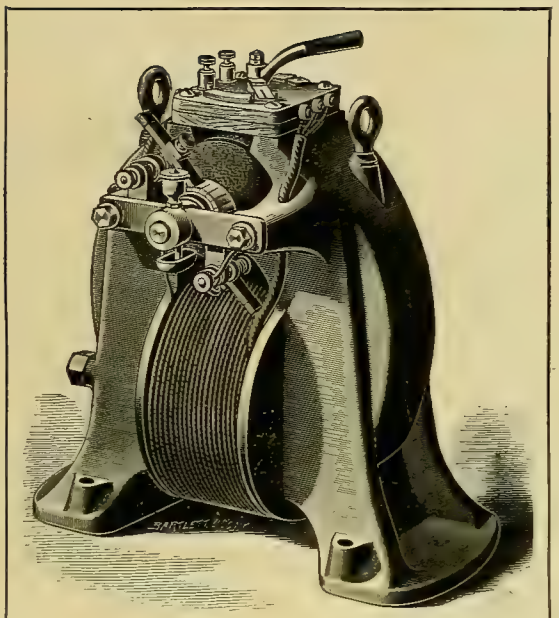
13 PARK ROW
NEW YORK.

BRANCHES BOSTON, CHICAGO, DENVER, SAN FRANCISCO, LONDON, SOUTH AMERICA.

THE UNITED STATES ELECTRIC LIGHTING CO.,

(THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Lessees.)

ARC AND INCANDESCENT ISOLATED ELECTRIC LIGHT PLANTS.



NEW U. S. MOTOR.

Automatic Dynamos.—Perfect Devices.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC

MOTORS and GENERATORS

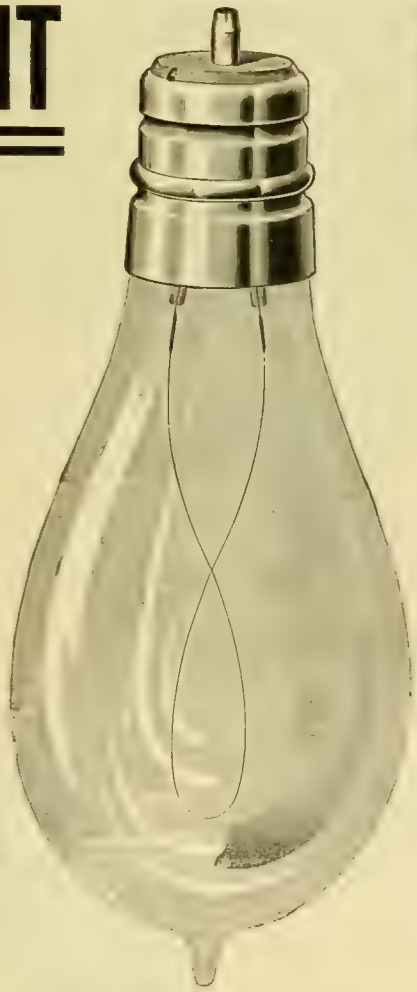
Direct Current GENERATORS and MOTORS for all purposes, 1-8 H. P. up to any power required, and at any required E. M. F.

Superior in Design and Workmanship, and Unequaled in Efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

GENERAL OFFICES: EQUITABLE BUILDING, - - 120 BROADWAY, NEW YORK.

INCANDESCENT LAMPS.



To Fit any Socket.

FROM 8 c. p. to 150 c. p., AND ANY VOLTAGE.

Excelling all others in Life, Maintenance of Candle-Power and Efficiency.

Even Diffusion of Light by twisted filament.

THE BEST IS THE CHEAPEST.

General Electrical Supplies of Superior Designs and Finish.

Send for our CATALOGUE of August 1, 1890.

SAWYER-MAN ELECTRIC CO.,

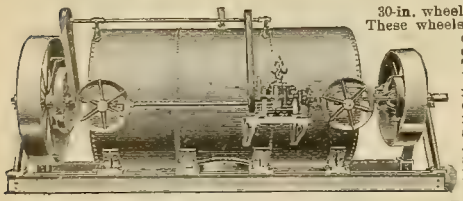
510-534 West 23d Street, NEW YORK.

620 Atlantic Avenue, BOSTON, MASS.

217 La Salle Street, CHICAGO. ILL.

RODNEY HUNT MACHINE CO.

Turbine Water Wheels, Vertical & Horizontal.



30-in. wheel at Holyoke Testing Flume .9050. These wheels are superior for high power and efficiency, excellent workmanship, even speed and great durability. Tight closing gate; easily operated. Used in many of the largest manufacturing establishments in the United States. 6 800 horse power furnished one mill, 7,200 to another, and one manufacturer 87 wheels. All now running. Special patented arrangements for electric light and power service, even speed, etc.

MAIN OFFICE and WORKS, Orange, Mass. BOSTON OFFICE, 70 Kilby Street.

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),
DAYTON, OHIO,

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

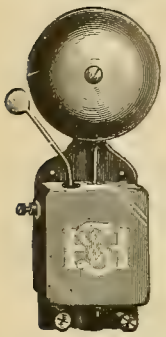
SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acids. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.



TWO CENTS

THAT'S ALL IT WILL COST YOU TO WRITE FOR PRICES.

WE CAN SAVE YOU MONEY.

STANLEY & HALL,

Electrical House Furnishings,

32 and 34 Frankfort Street, - NEW YORK.

CHAS. A. SCHIEREN & CO.,

NEW YORK. CHICAGO. BOSTON. PHILADELPHIA.

SEE OUR

BELTING ADVERTISEMENT

ON PAGE XXXII.

THE WESTON STANDARD

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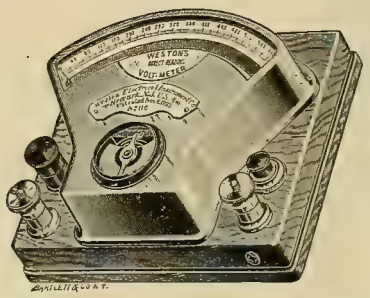

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Western Electrician.

EVERY SATURDAY.

Vol. VIII. CHICAGO, FEBRUARY 28, 1891. No. 9

Charles R. Huntley, President National Electric Light Association.

Charles R. Huntley of Buffalo, N. Y., who was elected president of the National Electric Light association, is one of the most popular members of the organization. Mr. Huntley is secretary and general manager of the Brush Electric Light company of Buffalo, N. Y. He has held that position during the last three years, and under his direction the company has been very successful. He has taken an active part in the affairs of the Electric Light association, and has devoted much time to promoting the interests of that organization.

Mr. Huntley, whose portrait is presented herewith, is comparatively a young man. He was born at Winfield, Herkimer county, N. Y., Oct. 12, 1854. His boyhood days were passed in Utica, and there he received his education in the public schools, finally passing through the Free Academy and completing his course His first business venture was in the Remington Arms company. After three years he went into the oil country, and in 1883 was agent for the United Pipe Line. Then he engaged in general brokerage business, dealing largely in oil, grain and stock. He continued in this line until 1888 when he went to Buffalo and engaged in the electrical business, assuming at that time his present position as secretary and general manager of the Brush Electric Light company.

Mr. Huntley's election gave general satisfaction. He announced that he would pursue a liberal policy, extending the influence of the association and making it what it should be, a promoter of the interest of the central stations. He believes that the convention at Montreal will have a good influence as it will tend to bring the Canadian companies into closer relation with the members of the association. He said it would be his aim to make the Canadian convention a memorable event in the history of the association.

CHARLES R. HUNTLEY, PRESIDENT OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

The Electric Light Association and the World's Fair.

Much interest was manifested by the Eastern members of the association in World's Fair matters. The report of the committee which President Perry presented expressed the willingness of the association as a body to promote the interest of the electrical department of the World's Fair. The members individually regard with interest the proceedings of the commission. A canvass of the opinion of the members showed them unanimously in favor of having a united electrical exhibition. The idea of dividing the electrical display was scouted by all and by many was received with indignant protests. It was generally conceded that to divide the electrical exhibit would be the greatest mistake that could be made and would practically spoil the effect of the crowning feature of the exposition. Generally speaking the members expressed confidence in the commission and it seemed to be the belief that the management of the fair would do nothing that would jeopard the interest of the exhibition or any feature of it. The announcement that Prof. Barrett would be unable to attend the convention was received with regret. The members extended to him, however, assurances of their support.

House Warming of the American Electrical Works.

The house warming of the new factory of the American Electrical Works at Providence, R. I, tendered to the members of the National Electric Light association and their ladies closed the festivities of the most successful convention yet held by the association. The new part of the factory in which the reception took place is a building 148 feet long and 40 feet in width. The large room covering the entire floor of the new building contains one row of columns running lengthwise through the center. These were beautifully decorated with flags and bunting. A row of incandescent electric lights runs between the columns and the walls on either side. Rare tropical plants and gorgeous flowers were everywhere and formed a bank at one end so as to completely hide the band of musicians who furnished delightful strains for the dance. The collation was served in the room above the dancing hall of equal dimentions and the tables were provided to seat the entire 500 guests. The reception committee were: Marsden J. Perry, C. H. Barney, Allen R. Foote, E. A. Maher, A. J. De Camp, Henry B. Crane, Chas. W. Price, C. B. Haskins, S. A. Duncan, M. A. Knapp, C. R. Huntley, F. W. Webster, N. T. Pulsifer, W. H. Sawyer, C. L. Edgar, E. F. Peck, F. A. Gilbert, B. F. Hamilton, R. F. Ross, A. M. Young, H. H. Fairbanks, Geo. C. Roe, E. B. Newton, E. D. Floyd and H. L. Lufkin. Twenty dances with the intermission for the collation kept the guests in the happiest mood. William A. Hathaway and P. C. Ackerman with their aids directed the dances, Mr. Hathaway being the leader of the cotillon. The souvenir of the occasion was a neat little undressed kid portfolio of handsome design which will be highly prized for its uniqueness, and at some future day will call to remembrance the delightful entertainment of the host, Eugene F. Phillips. The guests included prominent personages of the aristocratic city of Providence as well as the members of the association.

Attendance at the Convention.

As will be noted by glancing at the report of the proceedings of the National Electric Light association's convention in this issue, the attendance was very large, and included some of the most prominent members of the fraternity. President Perry had worked hard to make the convention attractive, and the members evidently appreciated his efforts. The setting aside of a day for the purpose of relating reminiscences was a happy idea, and the report of the speeches will prove not only interesting reading at the present day, but later on will form an important page in the history of the development of electrical industries.

The pioneers who related their experiences in such a happy vein to the convention at Providence may well look back to day with satisfaction over the victories they have achieved, for they have earned their present position by the hardest kind of toil, and have passed through many severe trials, experiencing some disappointments and reverses which would have made ordinary men falter. But they had faith in the idea they were developing, and they persisted in their experiments and studies until their efforts were finally crowned with success.

It is a noteworthy fact that the Western delegation was one of the largest in attendance, the central station men responding in large numbers. The Western members were enthusiastic in their support of the newly elected president, C. R. Huntley. He is extremely popular with them. It is expected that under his administration the membership will greatly increase, and the attendance of central station men at the convention will be greater than heretofore.

The visitors were enthusiastic in their praise of the retiring president and those who assisted him in the entertainment of the members. Providence, always noted among electrical men as a most hospitable city, quite outdid itself on this occasion, as delegates to the convention will testify. From a social as well as a practical standpoint the convention will always be regarded as one of the brightest spots in the history of the organization, and one of the happiest gatherings of the representatives of electrical interests.

Stockholders in the Bowling Green, Mo., Electrical company have elected the following officers: J. Creighton, president; Dr. B. A. Wilkes, vice-president; E. W. Major, secretary, L. M. Edwards, treasurer. The National system has been adopted by the company. The city will be lighted in about forty days.

THE CONVENTION

Of the National Electric Light Association, Providence, R. I.

The thirteenth convention of the National Electric Light association was held at Providence, R. I., Feb. 17, 18 and 19. Following is a list of the delegates and visitors:

MEMBERS AND VISITORS.

Ackerman, P. C ..... New York, N. Y.
Alexander, P. H ..... New York, N.Y.
Atkinson, E. P ..... Boston, Mass.
Amory, Robt ..... Boston, Mass.
Anderson, J. M ..... Boston, Mass.
Austin, Geo. L ..... Boston, Mass.
Andrews, D. A., Jr ..... Boston, Mass.
Armstrong, E. A ..... Camden, N. J.
Burdick, J. P ..... New York, N Y.
Burton, F. G ..... New York, N, Y.
Bushnell, N ..... New York, N. Y.
Bosworth, Chas. A ..... Providence, R. I.
Benton, C. A ..... Detroit, Mich.
Bullard. R. H ..... Bridgeport, Conn.
Caldwell, Edward ..... New York, N. Y.
Cabot, Geo. E ..... Boston, Mass.
Colvin, F. P ..... New York, N. Y.
Candee, W. L ..... New York, N. Y.
Cook, E L ..... New York, N. Y.
Coles, S. L ..... New York, N. Y.
Chalmers, David ..... New York, N. Y.
Castle, Wm. W ..... New York, N. Y.
Cheever, H. D ..... New York, N. Y.
Carey, R. B ..... New York, N. Y.
Collins, W. Forman ..... Chicago, Ill.
Clark, E. L ..... Chicago, Ill.
Clark, A. T ..... Boston, Mass.
Cram, Henry ..... Boston, Mass.
Eustis, H. H ..... Boston, Mass.
Edgar, C. L ..... Boston, Mass.
Ellinger, J. O ..... New York, N. Y.
Fowler, J. B ..... New Haven, Conn.
Ferguson, W. B ..... Boston, Mass.
Fowler, C. K ..... Boston, Mass.
Fineout, W. C ..... New York, N. Y.
Frey, C. P ..... Albany, N. Y.
Ferguson, Jas ..... Brooklyn, N. Y.
Fenner, H. W ..... Providence, R. I.
Francisco, M. J ..... Rutland, Vt.
Faben, Chas. R ..... Toledo, O.
Foote, A. R ..... Washington, D. C.
Floyd, Edward D ..... Boston, Mass.
Garver, M. M ..... Newark, N. J.
Greene, E B ..... Altoona, Pa.
Gregory, C. E ..... Chicago, Ill.
Gilman, A. K ..... Chicago, Ill.
Gilley, F. M ..... Boston, Mass.
Gray, R. J ..... New York, N. Y.

ELECTRICAL EXHIBITION IN UNION HALL—NATIONAL ELECTRIC LIGHT CONVENTION AT PROVIDENCE—(SEE PAGE 127.)

Arnold, Olney ..... Providence, R. I.
Abell, C. L ..... Buffalo, N. Y.
Ayer, Jas. J ..... St. Louis, Mo.
Baird, M. E ..... Boston, Mass.
Bailey, C. E ..... Providence, R. I.
Buck, G. M ..... Providence, R. I.
Brady, T. H ..... New Britain, Conn.
Baugher, F. W ..... Indianapolis, Ind.
Bates, F. C ..... Lynn, Mass.
Bubier, E. F ..... Lynn, Mass.
Baker, C. O., Jr ..... Newark, N. J.
Brown, C. A ..... Chicago, Ill.
Bryant, W. C ..... Bridgeport, Conn.
Burleigh, J. J ..... Camden, N. J.
Bradner, W. P ..... Denver, Colo.
Burdett, E. W ..... Boston, Mass.
Barton, S. E ..... Boston, Mass.
Barker, W. I ..... Boston, Mass.
Blackburn, E. D ..... Montpelier, Vt.
Barker, F. E ..... Boston, Mass.
Brophy, W. C ..... Boston, Mass.
Burnham, Lewis W ..... Boston, Mass.
Burnham, William ..... Boston, Mass.
Bibber, C. E ..... Boston, Mass.
Barney, C. H ..... New York, N. Y.
Bell, Louis ..... New York, N. Y.
Crane, F. H ..... Boston, Mass.
Conant, H. J ..... Boston, Mass.
Chase, H. W ..... Boston, Mass.
Chase, W. G ..... Boston, Mass.
Cook, W. J ..... Chicago, Ill.
Cook, J. H ..... Chicago, Ill.
Cutter, George ..... Chicago, Ill.
Clisdell, P. A ..... Syracuse, N. Y.
Chaffee, Z ..... Providence, R. I.
Carhart, E. M ..... Providence, R. I.
Carrier, A. E ..... Pittsburg, Pa.
Corriveau, A. J ..... Montreal, Can.
De Camp, A. J ..... Philadelphia, Pa.
Denison, J. F ..... New Haven, Conn.
Davis, E. W ..... Hartford, Conn.
Dean, D. B ..... Chicago, Ill.
De Land, Fred ..... New York, N. Y.
Draper, Paul A ..... Lynn, Mass.
Dillont, J. F ..... New York, N. Y.
De Ronde, F. S ..... New York, N. Y.
Douglass, S. A ..... Boston, Mass.
Davis, A. E ..... Boston, Mass.
Elwell, H. P ..... Providence, R. I.
Eleison, C. P ..... London, Eng.
Elliott, A ..... Manchester, Mass.
Everts, D. I ..... Boston, Mass.
Gordon, W. H ..... New York, N. Y.
Godfrey, J. W ..... New York, N. Y.
Gennert, E. F ..... New York, N. Y
Hammer, W. J ..... New York, N. Y.
Hunt, W. T ..... New York, N. Y.
Hungerford, D. L ..... New York, N. Y
Haskins, C. D ..... Boston, Mass.
Herrick, C. H ..... Boston, Mass.
Holtzer, C. W ..... Boston, Mass.
Huntley, C. R ..... Buffalo, N. Y.
Hatch, E. B ..... Hartford, Conn.
Harris, A. W ..... Providence, R. I.
Hines, J. L ..... Syracuse, N. Y.
Harrington, W. E ..... Atlantic City, N. J.
Howe, A. W ..... Providence, R. I.
Herrick, J. H ..... New York, N, Y.
Hill, W. S ..... Boston, Mass.
Ide, A. L ..... Springfield, Ill.
Johnston, W. J ..... New York, N. Y.
Jenney, C. D ..... Indianapolis, Ind.
Jenney, —— ..... Indianapolis, Ind.
Kaelber, J. G ..... New York, N. Y.
Kreidler, W. A ..... Chicago, Ill.
Kimball, A. R ..... Fort Wayne, Ind.
Kenfield, F. L ..... Chicago, Ill.
Knapp, M. A ..... Chicago, Ill.

Key, W. S. ..... Boston, Mass.
Ketchum, Joseph ..... New York, N. Y.
Lee, C. Fremont ..... Boston, Mass.
Lucas, H. P. ..... Chicago, Ill.
Lufkin, H. L. ..... New York, N. Y.
Leonard, H. Ward ..... New York N. Y.
Latshaw, Z. ..... New York, N. Y.
Law, M. D. ..... Denver, Colo.
Lynch, John ..... Washington, D. C.
Lincoln, L. C. ..... Woonsocket, R. I.
Leonard, F. H., Jr. ..... Syracuse, N. Y.
Love, W. S. ..... St. Louis, Mo.
Lawton, J. F. P. ..... Providence, R. I.
Ladd, H. W. ..... Providence, R. I.
Lewis, U. B. ..... Lynn, Mass.
Larue, Geo. ..... New York, N. Y.
Libby, C. L. ..... Bridgeport, Conn.
Lockwood, T. D. ..... Boston, Mass.
Lynch, John G. ..... Boston, Mass.
Manson, George T. ..... New York, N. Y.
Magee, Frank A. ..... New York, N. Y.
Martin, T. C. ..... New York, N. Y.
Meeker, Geo. H. ..... New York, N. Y.
Mendels, E. S. ..... New York, N. Y.
Myerson, E. ..... New York, N. Y.
Murray, W. J. ..... New York, N. Y.
Mitchell, A. P. ..... New York, N. Y.
Morrison, W. J. ..... Woodstock, Can.
McCoubray, T. B. ..... New York, N. Y.
McQuaide, J. P. ..... New York, N. Y.
Martin, Frank A. ..... Boston, Mass.
McGraw, J. H. ..... New York, N. Y.
Mullen, W. P. ..... Boston, Mass.
Monks, T. H. ..... Boston, Mass.
Mason, Jas. H. ..... Brooklyn, N. Y.
Morris, W. D. ..... New York, N. Y.
Mason, A. F. ..... Boston, Mass.
Mason, W. R. ..... Chicago, Ill.
Mansfield, J. R. ..... Boston, Mass.
Markland, W. H. ..... Altoona, Pa.
Minott, Fred S. ..... Bristol, Conn.
McIntyre, C. H. ..... Newark, N. J.
Moore, A. E. ..... Philadelphia, Pa.
Marshall, Norman ..... Philadelphia, Pa
Marsh, J. W. ..... Pittsburg, Pa
Mason, E. P. ..... Providence, R. I.
Mills, A. H. ..... Waterbury, Conn.
Maynard, George C. ..... Washington, D. C.
Newton, C. E. ..... Hartford, Conn.
Newton, A. D. ..... Windsor, Conn.
Nicholls, Fred ..... Toronto, Can.
Nichols, W. L. ..... Hope Valley, R. I.
O'Hara, John B. ..... Chicago, Ill.
Orford, J. M. ..... Bridgeport, Conn.
O'Connor, I. F. ..... New York, N. Y.
Outcault, R. F. ..... New York, N. Y.
Packard, W. D. ..... Warren, O.
Perrine, F. A. C. ..... Trenton, N. J.
Perry, M. J. ..... Providence, R. I.
Phillips, E. F. ..... Providence, R. I.
Paiste, H. T. ..... Philadelphia, Pa.
Powers, E. L. ..... Chicago, Ill.
Pettingell, F. E. ..... Boston, Mass.
Preston, Jarvis F. ..... Boston, Mass.
Potter, D. F. ..... Boston, Mass.
Paine, S. B. ..... Boston, Mass.
Paine, C. McL. ..... New York, N. Y.
Pope, R. W. ..... New York, N. Y.
Phelps, G. M. ..... New York, N. Y.
Price, C. W. ..... New York, N. Y.
Peck, E. H. ..... New York, N. Y.
Pierrez, J. C. ..... New York, N. Y.
Platt, W. H. ..... New York, N. Y.
Pilicy, W. J. ..... New York, N. Y.
Peck, E. F. ..... Brooklyn, N. Y.
Ryan, R. W. ..... New York, N. Y.
Ridlon, Frank A. ..... Boston, Mass.
Ross, R. F. ..... Boston, Mass.
Robertson, A. M. ..... Minneapolis, Minn.
Remington, G. H. ..... Providence, R. I.
Royce, F. W. ..... Washington, D. C.
Rogers, W. ..... Hope Valley, R. I.
Rodman, C. L. ..... Cleveland, O.
Rich, A. F. ..... Brooklyn, N. Y.
Rollins, E. W. ..... Denver, Colo.
Roebuck, Thos G. ..... New York, N. Y.
Rosentam, S. ..... New York, N. Y.
Rice, E. Wilbur ..... Boston, Mass.
Shay, J. H. ..... Chicago, Ill.
Stow, W. E. ..... Boston, Mass.
Stillman, G. G. ..... Boston, Mass.
Sharp, E D. ..... Boston, Mass.
Stanley, H. D. ..... Bridgeport, Conn.
Spooner, W. H. ..... Bristol, Conn.
Sims, G. C. ..... Providence, R. I.
Sawyer, W. H. ..... Providence, R. I.
Shultz J. A. J. ..... St. Louis, Mo.
Stump, C. E. ..... New York, N. Y.
Sullivan, M. C. ..... New York, N. Y.
Sellers, W. G. ..... New York, N. Y.
Sweatland H. M. ..... New York, N. Y
Sanford, C. E. ..... New York, N. Y.
Schieren, C. A., Jr ..... New York N. Y.
Seeley, J. A. ..... New York, N. Y
Shippy, H. L. ..... New York, N. Y.
Shainwald, R. L. ..... New York, N. Y.
Sprague, Frank J. ..... New York N. Y.
Stetzel, George T ..... New Bedford, Mass.
Temple, W. H. ..... New York, N. Y
Taltavall, T. R. ..... New York, N. Y.
Taltavall, J. B. ..... New York, N. Y.
Truax, C. R. ..... New York, N. Y.
Tysen, F. C. ..... Wilmington, Del.
Talcott, A. F. ..... Boston, Mass.
Terry, F. S. ..... Chicago, Ill.
Urquhart D. J. ..... Fremont, O.
Vialle, W. H. ..... Worcester, Mass.
Vaughan, D. W. ..... New York, N. Y.
Van Nuis, C S. ..... New York, N. Y.
Van Trump, C. Reginald ..... Wilmington, Del.
Willyoung, E. A. ..... Philadelphia, Pa.
Wisner, F. P. ..... New Brunswick, Conn.
Whitney, L. C. ..... New Britain, Conn.
Wilcox, L. E. ..... Meriden, Conn.
Weeks, E. R. ..... Kansas City. Mo.
Wightman, E. T. ..... Danbury, Conn.
Wirt, Charles ..... Chicago, Ill.
Wheeler, Howard ..... Boston, Mass.
Willard, C. F. ..... Boston, Mass.
Wilkins, A. Ward ..... Philadelphia, Pa.
Wisner, Frank P. ..... New Brunswick, N. J.
Walsh, L. ..... New York, N. Y.
White, R. T. ..... Boston, Mass.
Warner, W. D. ..... Boston, Mass.
Wyman, Ferd A. ..... Boston, Mass.
Wallis, Louis R. ..... Boston, Mass.
Wheeler, Howard ..... Boston, Mass.
Watkins, J. E. ..... Washington, D. C.
Wood, E. E. ..... New York, N. Y.
Wetmore, J. A. ..... New York, N. Y.
Walker, G. W. ..... New York, N. Y.
Whipple, F. H. ..... New York, N. Y.
Wheeler, S. S. ..... New York, N. Y.
Weinburg, W. J. ..... New York, N. Y.
Wetzler, J. ..... New York, N. Y.
Western, B. R. ..... New York, N. Y.
Wilkins, Fred ..... New York, N. Y.
Wilson, F. B. ..... Hartford, Conn.
Wiley, G. L. ..... New York, N. Y.
Young, John ..... Chicago, Ill.

Tuesday's Proceedings.

President Marsden J. Perry called the convention to order at 11:15 A. M., in Freemasons' Hall, and introduced the Hon. Charles Sidney Smith, mayor of Providence, who spoke as follows:

Address of Welcome.

I esteem it a high compliment, the kindness which your president has bestowed upon me in asking me to extend to you a cordial welcome to our city. My fellow citizens feel highly honored by your presence among us. I certainly wish that your semi-annual convention might have been held here in the summer months when we could have shown you an institution peculiar to ourselves, and to which I very much doubt that the application of electricity as a motive power would have in any way improved, to-wit: our method of dispatching claims. It is an institution peculiar to Rhode Island. Our city is large in population, has industries diversified, and some of them of the finest, and many of them of the largest, I think, in the world. We are perhaps not so thoroughly acquainted with the subjects which you will discuss as we ought to be, or as many of us desire to be. There is an element in our community like all others fearful of its results. Some men, by reason of their habits of life, I may say, are always fearful of death; men often flee when no one pursueth. "The wicked flee when no man pursueth." Before you get through with your convention I hope you will be able to tell us whether there is any danger in that matter which we are so earnestly discussing at the present day, namely, the application of electricity as a motive power to street cars. We need it very much in some form or other.

President's Address.

President Perry then delivered his annual address, which follows:

At this, our thirteenth convention, we have a double duty to perform—a duty to the past, a duty for the future. We who are absorbed with dealing with the problems of to-day, and attempting to reach a little way into the future by anticipating the demands that may be made upon us, can well afford to pause a moment to pay a fitting tribute to those whose labors in the past have made our present possible.

We are here to pay to the pioneers of the electrical industries, a tribute of intelligent appreciation, and to recognize in a formal manner the magnificent realization of the inventor's hopes and the scientist's dreams, to erect a milestone that shall mark the closing of the first decade of the practical commercial application of electricity, a development which has shown grander results than ever before known in the industrial history of the world. I ask you to step back a few years, to the time when no electrical work as we know it, was in existence, and from that standpoint measure the meaning and value of what has since been done.

We are told that Franklin's kite experiment was made in 1752, and that in 1753 he invented the lightning rod. The age of electricity may be reckoned from that date

In the year 85, after Franklin, the first electrical company in the world was incorporated by a charter granted by the state of Rhode Island. This charter was granted in June, 1838, to E. J. Mallett and his associates, successors and assigns. By whose genius it was conceived, and what became of those aboriginees of the electrical age, I cannot tell you. That Mr. Mallett and his associates, whoever they were, no other name is mentioned in the charter, were true prophets of science and industry, is unmistakably shown in their marvelous conception of the possibilities of their undertaking. The third section of their charter is as follows: "The said corporation shall have power to cause experiments to be made in electro magnetism, magnetism and galvanism, with a view of the development of said sciences, as a motive power for machinery or other useful purposes; also, to manufacture the necessary machinery and other apparatus therefor, to build and construct boats, vessels, railroad cars, and engines to be moved by electro magnetism, magnetism or galvanism." Has any one today a broader view of the possibilities of electric power than this?

In selecting Providence for the meeting place of your thirteenth convention, you builded better than you knew. You not only at this time celebrate the first decade of electric lighting, but you celebrate it in the birthplace of far-reaching appreciation of electric power.

In the year 91 after Franklin, Morse constructed the first practical telegraph line; he connected Washington with Baltimore by telegraph in 1844. Seven years before that he exhibited his telegraph in the University of New York. Between invention and success there were seven years of working and waiting.

In the year 113 after Franklin, Field laid the first successful ocean cable (1866.) Eight years before, a cable was laid which operated but a few weeks. Before success, there were eight years of patient, courageous work, such as man has seldom had the power to endure.

In the year 122 after Franklin, Bell gave the telephone to society (1875), and made all the people of the town neighbors. His years of faithful work preceding crowning success are well remembered.

In the year 125 after Franklin, Brush exhibited a light that caused people to think the sun had forgotten to set at the ordained hour. The first time the public ever saw a lamp burning in series was at the exhibition of the American Institute, held at New York, September 11th to November 23d, 1878.

Two isolated plants were then sold, consisting of a six light Brush dynamo and six series lamps. One went to Losier & Co., dry goods merchants of Brooklyn, N. Y. The other went to Freeland, Loomis & Co., Continental Clothing House, Boston, Mass.

The first arc light central station was installed by the California Electric Light company, of San Francisco, in 1879.

In the year 127 after Franklin, Edison divided the electric current and produced miniature suns that might be placed wherever more light was desired for use or pleasure.

The first Edison isolated plant was installed in 1880 in the printing establishment of the Hinds & Ketcham company, Brooklyn, N. Y. A paragraph in a circular issued by this company under date of Feb. 1, 1881, is as follows: "Our building is 40x160, four floors lighted on all sides and fitted throughout with Edison incandescent lights, operated by a special dynamo electric machine operated on the premises. We are the first manufacturers in the world to put into practical operation this great triumph of American genius which is a true substitute for daylight, showing all colors in their natural hues, and our friends are invited to call and see the operation of Professor Edison's wonderful subdivision of the electric current and vacuum lamp."

Mr. Hinds writes: "I think the proudest moment of my life was when I turned on the switch for the first time and saw the room lighted up by what seemed to be the greatest wonder of the world, the incandescent lamp."

The first steamship electric plant was one of Edison's installed with 120 lamps in the steamship "Columbia" of the Oregon Railroad and Navigation company, Jan. 10, 1881.

The first Edison central station was installed with 4,000 lamps in Pearl street, New York City, September 4, 1882, To start this plant Edison had to overcome more than electrical, mechanical and financial difficulties. He had New York aldermen to deal with. The following occurs in an interview with Edison, published in the New York *Herald*, January 20, 1881:

"When will you be ready to light New York?"

"Edison replies: "I am ready now but we have no permit. I find it hard to get the requisite aldermanic condition The company laid an application before the board. The application was referred to the laws committee and was reported back saddled with conditions which savor of a body of gas men rather than public servants. They wanted in the first place the company to pay ten cents per lineal foot for all wire laid down. That would be twenty cents for every foot of street, for we would run wires on both sides. That is over $1,000 a mile. This, too, when gas companies pay not a cent, The second clause was that we should light the streets at 10 per cent. above actual cost; the third clause was that after five years, 3 per cent. of gross receipts shall go to the city."

This is an example of encouragement given by the first city in America to American genius, skill and enterprise.

Ten years ago the only electric currents in use, were the feeble currents of the telegraph and telephone. There was then not a lineman nor a workman of any kind who had ever heard of high tension currents we are using to-day for the services of light and power. No man had ever handled conductors carrying such currents, nor manufacturing apparatus for operating them excepting in an experimental way. There was not an educational institution giving a course of technical training in electrical engineering Consider this, then behold what has been accomplished in the first decade of electric lighting. A period of time no longer than Morse, Field and Bell were compelled to wait and work to span the chasm lying between invention and practical success.

Confine your observation exclusively to the United States and you will find the electric light in use by 6,000 isolated plants, 700 steamboats of American register, 350 gas companies furnishing electric light and power. There are 200 street railroads operated by electric power, 1,500 electric lighting and power stations. Facts like these need no embellishment to make them eloquent.

Now look beyond the limits of this country and see the development of electrical industry throughout the world, during this first decade. Never before has such a transformation taken place. And this is not the end, it is but the beginning of things that are to be.

American genius, skill and pluck has, in all departments of industry, secured within this century benefits of high value for all mankind. That this truth may be known for all time, it is our duty to preserve in the most durable and instructive form proper records of the achievement of all American industrial pioneers. Soon

a fitting opportunity will present itself for the celebration of the first one hundred years by duly honoring the beginning of the second century of the American patent system. In that grand marshaling of those who made prophecies and who fulfilled them, who had the genius to see, and the skill, courage and patience to execute, we must see to it that electrical workers occupy their rightful place of honor. The interest begun here should reach full tide then, and should culminate in placing in the National Museum at Washington a collection of drawings, models, relics, etc., illustrating the birth and development of electrical industries in America. Such a collection should give at a glance to the unskilled workman or the general public an intelligent idea of successive steps of progress and invention and construction that have led from the beginning of the telegraph and telephone to those systems of communication as at present perfected from the first production of an electric spark to the light we now have; from the first lifting of a weight by an electric magnet to the present marvelous manifestations of electric power. It is of the highest importance that such a collection be made and preserved, not alone for the instruction of the people of our time, but as history for all, written in the forms of the things we use, thus enabling future investigators to determine the relative influence of the electrical industries in forming the character of our civilization, and in enhancing the degree of our prosperity.

One point is worthy of emphasis while engaged in this review. This is the year 138 after Franklin. Would society consent to be placed back to the conditions it was in when Franklin made his kite experiment, if it could thereby recover from the pioneers in electrical work all that they have personally retained from the health that has been cheated by developments from their initial undertakings? No; not for a single day. They have given to society benefits a thousand times more valuable than all they have received, or that it is possible to confer upon them. Their services are of that divine order in the measuring of which money values are impotent. Limits of time and space are unknown to them. They are with us, and others, but they take cognizance of no country, no race or generation. Their field is the universe. The benefits of their services are for all men. They receive tribute of grateful honor from all intelligence Their work is of the past. Our work is the future. What report shall be made at the celebration of the close of the second decade of electric lighting and power? The first Edison station has increased its capacity from 4,000 to 15,000 lamps in eight years. At this rate of increase this plant will be supplying 60,000 lamps ten years hence. We cannot measure the limits of future developments. We have done much, but we have produced only a sample of what is to be. An observer states that there is not a plant in existence having a sufficient capacity to supply one-twentieth of the demand for light and power that now exists within practical working limits of its area of distribution. If this be true, then within ten years, if each station is to fully occupy its territory and keep pace with the growth of population, its capacity may be increased many times

The central station men of this country do not realize the possibilities of development that lie before them. They do not see many sources of income that are as yet untouched. The accelerated pace at which progress is now moving, will render the work of the next ten years enormously greater than all that was accomplished during 138 years after Franklin. The car of progress will not stop for us any more than it did for those who were before us. We have given it momentum, but we cannot hinder it. Let it be our ambition then, as it is our duty, to supply every demand for every kind of light and power service within reach of our stations. Those of you who not do this, will induce competitors to come within your limits, to divide your business and erect an obstacle in the way of your growth that can be overcome only by buying out, or selling to the intruder. To-day the whole territory is yours to hold, to occupy, to serve. Be the equal of your opportunity and at the second decennial celebration of electric light and power the capacity of your plant may be many times what it is to-day.

The records of the beginning of the electrical industries are being written for the imperishable pages of history. We have gained the strength of the difficulties that have been overcome like the armies of volunteers that made ours a free nation. The forces now engaged in electrical work were recruited from every vocation. To-day, over thirty educational institutions of high grade are preparing the best brains among young men to do scientific and technical work. The practical American workman who has proven by what he has done that his rank is second to none, the peer of skilled workmen of the world, is educating his helpers and associates in the practical school of daily occupation.

Enterprise is ever young. We are incidents. Industry, like human energy and force, will go on forever. When we tire and seek our rest, younger men will be eager to fill our places. Let us then begin where we may. Let us honor ourselves by fulfilling our double duty, which is to duly honor those who have placed us under obligation for the work they have done in the past, and so to do our work, that our successors shall have equal cause for honoring us.

I now declare the Thirteenth Convention to be opened for the transaction of business.

Invitations.

The secretary read invitations from the Providence Telephone company, the Union Club of Providence, the Providence Board of Trade, the Corliss Steam Engine company, and the Rhode Island Tool company, all of which were accepted.

A card from Eugene F. Phillips containing the following was read: "The pleasure of your company with ladies is requested at a house warming tendered to the members of the National Electric Light association, and their ladies on Thursday evening, February the 19th, 1891, at the new factory of the American Electrical Works, Stewart street, Providence. Grand march at 9 o'clock." This, too, was accepted.

Ralph W. Pope presented the following: The Fifty-fourth meeting of the American Institute of Electrical Engineers will be held at the rooms of the Institute No. 12 West Thirty-first street, New York City, Tuesday evening, February 24th. A paper will be read by Oscar T. Crosby of Boston, entitled "Data and Results of Experiments with Electric Traction at 120 miles an hour." A working model of the electric railway made by Thomas Davenport in 1837, will also be exhibited in actual operation, and some interesting facts regarding its history will be given by Franklin L. Pope. Your association and the institute have many members in common, and for this reason the meeting has been postponed from its regular date in order that those who desire to do so might attend the Providence convention without missing the meeting of the institute. The council extends to the members of the National Electric Light association a cordial invitation to attend this meeting, and hopes that many of them may find it convenient to do so in view of the fact that many will return home by way of New York, and also that the question of rapid transit will be discussed at the Electric club on Thursday of the same week. I might say that about the time referred to by the president a model of Thomas Davenport's was exhibited in Boston, and it is very possible that the researches made by this Vermont blacksmith were among the reasons that led to the formation of the company in Rhode Island to which the president refers I think that this forms a very interesting fact in the historical progress of electricity.

Report of the Committee on Copper.

The President: The first order of business will be the report of the committee on copper tariff by Charles A. Brown.

Mr. Brown: The committee on copper tariff has practically no report to make. At the last convention we reported the progress that we had made at that time. The reduction of the duty on copper was, as you all know, embodied in the McKinley bill, which became a law, and there is now a very low rate of duty—something like twenty per cent. of the former rate of duty on copper in its various forms. This bill having become a law, and this being now the duty on copper, and no further action being required at the hands of this committee, I would suggest that the committee be discharged.

The committee was accordingly discharged.

Mr. Brown: If it is in order I have a telegram here from J. P. Barrett, chief of the Bureau of Electricity of the World's Columbian Exposition, expressing his sincere regret that he is unable to be present at the meeting of the Electric Light association. The serious illness of one of his children makes it necessary for him to remain in Chicago. He sends his best wishes for the success of this convention, and of the National Electric Light association.

The communication was received and placed on file.

The next order of business is the reading of a paper on "Electric Lighting as Applied to Steam Railroads," by W. H Markland.

Mr. Markland read the following paper:

The Electric Light, as Applied and Used by Steam Railroads.

BY W. H. MARKLAND.

Among the first to make use of the advantages afforded by electric lighting were the steam railroads; not as a means for lighting trains, but for lighting buildings, etc In the year 1881 the Pennsylvania Railroad introduced its first electric lighting plant in a new shop in Altoona That proved quite a success. It might also be mentioned that the same dynamo and lamps are in use to-day. In the year 1885 the Pennsylvania Railroad commenced lighting its depot shed in Altoona by arc electric light from its own dynamos, which proved a success as compared with the previous gas light, although it was crude to what the company now has.

The question then presented itself: Can freight yards be successfully lighted by electricity to reduce accidents, facilitate business and prevent breakage of cars and contents? The two latter items are quite a money consideration on any railroad. Some previous attempts had been made at lighting railroad yards by electricity, but without much success previous to the attempt in Altoona. I speak particularly of the Pennsylvania Railroad in Altoona, as I am very familiar with the lighting that has been done there, and also because what the Pennsylvania Railroad does is liable to be copied by other roads; and we sometimes get good ideas from other roads.

In Altoona, when drawing up the plan for lighting the yards, the question presented itself: How high and how near together shall the lights be placed? the problem of lighting the freight yard being more complicated than lighting a city; as in lighting a city lamps can generally be placed at street corners and quite low, the general public being not over particular, so that under, or near, the lamp the light is quite brilliant, but in the space between lamps there is less brilliancy.

For lighting, where engineers and trainmen have to work, it is not the brilliant light that is wanted, but the evenly distributed light. If a light be too brilliant, trainmen when near lamps will be partially blinded, as we might call it, for a short time; so in the event of their leaving a lighted space it would be difficult for them to distinguish objects or signals and would lead to complaints.

In order to get an evenly distributed light, lamps in Altoona were placed on top of 65-foot poles, these being about eight feet in the ground, and set so as to illuminate switches and crossovers where the yards were narrow. Where yards were wide and long lamps were placed about 600 feet apart, a row on one side of the yard and a row in a broad alley that was wisely left between tracks near the opposite side of the yard, the lights of the two rows being zig-zagged to prevent shadows and to better diffuse the light. This plan of lighting does not make a brilliant light at any point, it being possible, but difficult, to read fine print. A light more like moonlight was the result, and proved very good in practice. Even a clear globe was objectionable on account of the shadows of side arms. A lower half ground globe was preferable, it having been proved by experience that it was better to lose a little light than to have shadows.

One noticeable result followed the introduction of this light. It enabled the car inspectors to examine cars much more thoroughly, and as you all know, perfect car inspection is very important. A decreased amount of pilferage also followed, as the watchmen were able to see persons at a great distance at night. The breakage of cars and their contents was but little, if any, greater at night than in daytime. I cannot say how much money was saved by the introduction of the electric light from pilferage and breakage of cars and contents, yet I believe it was really more than the cost of maintaining the lights.

Undoubtedly the introduction of the electric light has prevented accidents to employes; of course I cannot say to what extent.

The electric lights are certainly a great help in shifting cars, as it enables the trainmen to see the tracks and position of switch points about as well at night as in the daytime; on account of the light shining on the top of the rails, which being generally bright from passage over them, a sort of reflector is made. Also in coupling and dropping cars it enables the brakemen to gauge the distance the cars are apart fully as well at night as in the daytime, so cars can be coupled without any more jar or danger than by daylight. It also assists in dropping or switching cars very fast, as is often necessary during a time of increased traffic. It enables the switchmen in the towers to tell when a car is over a switch, so that they can quickly throw the switches with less danger of throwing the cars off the track or on the wrong track.

A few words about the erection of arc lamps and poles for freight yards: Poles must be very well set in the ground, and guyed so as not to sway from heavy rolling stock passing, or from wind. The poles, being high, receive the full benefit of the wind. A good, true chestnut pole for lamps, if possible to obtain, answers very well. They will cost when shaved, stepped and erected with hood about $35. The price will be governed largely by the cost of timber. Short poles must also be well put up, so that there may be no breaks.

Railroad people are very exacting; it does not do to have any stops or shut-downs. The lamps must be kept in good order. Maintaining arc lamps near railroads is quite different from maintaining lamps in most stores. If there is a poorly insulated part in the lamp, the soot will soon find a path for the current across the poor insulation, and out goes your lamp. Your cut-out contacts will corrode very fast. When it comes to your rods expect to have a lot of dirty ones. In a railroad yard there are things to contend with not common with most lighting, and that is smoke and steam. I have seen poles covered from one end to the other with a film of soot from engines. This in getting on the hanger boards is sure to make escape unless the insulation be very good. The insulation should also be good to enable the inspector to work at a lamp, in case of its failing to burn, when the current is on.

Get a good, reliable, direct-current double carbon arc lamp that is well insulated. A lamp that is heavy, bulky, or having liquid is not well adapted for the purpose, on account of the difficulty of carrying it up the pole. Do not rely on the hooks of lamps for connection between the lamp and the hanger board, or they will corrode and cause trouble. It is better to always put a piece of flexible wire from the hanger board to the lamp to carry the current. Always use a good insulated wire and good insulators when running up poles or side arms. It is better to splice on a piece of the very best insulated wire. Experience has proved that the wooden part of hanger boards is better for having some waterproof insulation between it and the side irons to prevent leaks.

I do not favor double-pole switches on hanger boards in freight yards, as they require extra contacts, the brass work of which soon corrodes so as not to make good connections and leads to trouble.

The dynamo should be self-regulating and easily kept in order. As there may be 100 lamps, taking, say, two dynamos for all lighting at one point, it is better to put a little more money into dynamos than to pay high wages to the dynamo tender.

Keep as far away from telegraph and telephone lines as possible. If any damage is done to either of the above, the railroad generally gets the worst of the suit.

If you are going to hire the lights from a central station, see that they give you good work, and make a contract with a rebate and fine for the time lights are out.

If you once properly put electric lights in a freight yard, you will never get them out again; the trainmen will not stand it, as they would be in the dark in more senses than one if the lights were taken away. But if the lights are not properly put in, say, on low poles, under 40 feet above ground, or not properly spaced, the chances are there will be complaints on account of too much light at some one point, and too much darkness at some other point. Great care should be taken to place lamps so they will not interfere with signals. I have seen cases where electric lights were so placed that a signal could not be properly distinguished on account of the electric light shining on the lenses and blending the colors. A case like this can generally be avoided by placing some arrangement so the electric light will not shine on the signal.

The electric light is rather a help to distinguish the position of the semaphore arm, although trainmen at night look for the color of the lens rather than the position of the arm.

The electric light is something of a help in distinguishing the switch signals, on account of the lights shining on the lenses. These being low, the light will rarely show through them.

If it comes to a question of moving an electric light or a signal, you will find that the electric light will have to go

every time, as railroads will not allow any interference with signals.

If you go too high, you will not get the full benefit of the light, as has been proved where the tower system of lighting is in use.

In laying out freight yards, a broad alley, say 12 feet between tracks, should be allowed for placing the lamp poles, where the yards are over 300 feet wide.

As to the other uses for electric lights for railroads, I do not know. I do not know that there is much out of the regular run. The light is used quite extensively for lighting depot sheds, where it is more economical than gas, and decidedly better. This class of installation requires the very best of work and insulation, as the smoke and steam nuisance enters in here. Even though depot sheds are dry inside, porcelain knobs should not be used, glass with a double petticoat being the only kind now on the market that answers the requirements well, on account of the soot settling on the insulators.

It does not do to have a depot in darkness; for that reason a depot shed should be wired with two complete circuits, having every alternate lamp connected to one circuit and the remainder to the other. Then, in the event of a break in the wire, only one half the lights are out.

Experience has proved that the arc light is much superior to the incandescent for depot shed lighting. With incandescent lights the necessary volume of light is costly to maintain, and also the globes of incandescent lamps soon become dirty from steam and smoke, which interferes with the light, or if cleaned off necessitates considerable labor.

For freight transfer stations the arc light is very satisfactory. It enables the men to quickly distinguish marks on merchandise, and also enables the foremen to see what the men are doing, preventing loafing. One 2,000 nominal candle power arc lamp to about 1,500 square feet of floor space will generally light a transfer station where lamps can be zig-zagged. Where transfer stations are narrow more light per square foot should be allowed. On a platform about 10 feet wide, as they generally are, one light every 60 feet gives good illumination.

I doubt if the arc light can compete with gas for this purpose as far as cost is concerned, taking transfer stations as they are generally lighted by gas, and as they should be lighted by arc lights. Yet I believe, taking the amount saved in labor and from pilferage, that the electric lights more than pay for themselves.

Another point comes in here. We all know that on a wet, dark day we do not feel inclined to work as we do on a bright, sunny day. The same is the case at night; if you give men good light it brightens their spirits up and they will work much more cheerfully; and getting men cheerful means more work done.

For offices and shops the electric light is used considerably, much the same as for other places of like nature.

I hear that an electric headlight has lately been brought out which it is claimed will i luminate a track for a mile or more. I am of the opinion that the light will not come into general use. In the first place, a light for this purpose should not be too strong, or it will b ind an engineer coming in the opposite direction, this being a serious objection. Most of the roads east of the Ohio are not very straight, and the chances are that while on curves the neighboring cornfield will receive more light than the track ahead, as no one has invented a light that will show around the corner.

If any inventor wishes to get up an electric locomotive headlight, let him confine himself to one of low candle power—the present ones are about 20-candle power. I do not think one of over 100 candle power will be in demand until railroads are illuminated from one end to the other by electric light, which will be the case in the future, and then the headlight will not be required.

These points are necessary for an electric headlight: First, and all important, reliability; second, simplicity. Economy you can leave out. If you can get 50 per cent. of what can be attained in a station, it will do. One thing must be borne in mind—engineers are not electricians. Thus a dynamo and lamp must be as simple as the air-brake, and no more liable to get out of order.

The experiment has been tried of lighting cars by electricity. While it has proved a success in some cases, as far as convenience is concerned, financially it has not proved a success. Electric lighting of trains is a luxury to-day, and will continue to be until some more economical plan is invented. The advance that is being made with the use of gas as an illuminant for cars is leaving electricity behind. From the best information I can get, it costs 50 cents per hour to light a car by electricity from storage batteries, against five cents per hour from carbureted air.

The electric light is used to some extent by different railroads for lighting wrecks or any construction work that requires night work. For this purpose the Pennsylvania Railroad and the Cumberland Valley road have a car fitted up with boiler, dynamo, engine, water tanks and coal bunker, and all the tools necessary for a central station. With a car of this description, quick work in getting lamps in place is all important. In one case, after the Johnstown flood, I, with the help of four men and the engineer, put up six arc lamps, put up the poles for the lamps, which were designed for the purpose and carried on the car, ran the wire, coupled up the lamps, and had the lamps going in thirty-five minutes from the time we, with the car, lamps, poles and wire, arrived on the ground. The lights were distributed some distance, one being about one third of a mile away. I doubt if construction work was ever done quicker.

I will not go into a description of this car, as it was very ably explained by W. F. Taylor of Altoona, at the convention of railroad telegraph superintendents at Niagara Falls, June 19, 1890.

To give an idea of what the Pennsylvania Railroad company thinks of the electric light, I might say that its new Juniata shops at Altoona, having about 100,000 square feet of floor space, are lighted entirely by the electric light; there is not a pipe for illuminating gas in any of the buildings. All the traveling cranes are run by electricity.

The Pennsylvania Railroad company believes that good electric work pays I doubt if any station, central or isolated, has more reliable or better designed appliances, or more artistic work than can be found at the Juniata shops of that company.

DISCUSSION.

MR. DECAMP: I remember six or seven years ago that it was reported that the Pennsylvania Railroad company had appropriated a certain amount of money for the experiment of lighting cars, which has been referred to in Mr. Markland's paper—not only electric lighting, but experimenting with various forms of lighting by gas and oil. I had some knowledge at the time of the use of the storage battery The other methods of car lighting by electricity I know nothing about. If the gentlemen can tell us what are the precise conclusions of the railroad company as to the relative merits of electric lighting as compared with any other form, and particularly as to the different methods used in electric lighting, either by battery or direct from the dynamo, I think it would be very interesting and useful to the association.

MR. MARKLAND: I may say that the question of lighting cars by electricity is somewhat out of my department, but I should say that six or eight years ago we tried experiments with the storage battery. We first had the storage battery under the car. That was tried for awhile, but not with very much success. Then the railroad company made nine or ten cars for use between Jersey City and Philadelphia. Those were all lighted from storage batteries. We had a certain amount of success. It was rather a difficult matter, though, as we had to charge the batteries at Jersey City; if we had a dark day, and then had to run the cars back to Jersey City at night, the chances were we would have to come back with no light, which, of course, was not very pleasant. I think they equipped probably fifteen or twenty cars with the storage battery under that plan, and they tried almost every kind of a storage battery without any greater success. I might say, by the way, that we have thrown the batteries all away now and have put in gas. The Pullman limited, as you may all know, is lighted from a dynamo in the baggage car, and storage batteries in the cars.

M. J. FRANCISCO: We all appreciate the value of a good light around a big wreck in the night time, but the most interesting thing to me, in connection with the Pennsylvania Railroad experiments in electric lighting in our part of the country, is that they have decided to buy their lights of our company.

J. J. BURLEIGH: I have been furnishing light to the Central Vermont Railroad company for the last two years, lighting the railroad yard, the station and the roundhouse. Mr. Markland's theory of the best plans is the same that we have adopted there, by placing lights upon the tops of poles. Our poles are fifty feet above the ground, with lamps on top of them. We find very serious trouble in the old style of roundhouse with a dome at the top, and a platform in the center to transfer the engines to different tracks. Of course our lamp hangs in the center, and every engine that comes in stops on that platform, and opens her pipe and throws the dust and soot and everything up where it settles on the lamp. Naturally it covers not only the lamp but the whole top of the building, so that in many cases you will find the dirt an inch deep. We have trouble by getting short circuits on the lamp from that stuff gathering and making one solid block on the lamp. Now, if Mr. Markland has any suggestions we should be very glad to receive them.

In the stations we use the arc lights, suspended from different parts of the station. We have had a great deal of trouble in preventing the lights from being short-circuited.

MR. POPE: It is one of the arguments against electricity that it is dangerous, and one of the reasons why it has been adopted for car lighting, although expensive, is because it is safe. In going out on the Jersey Central road the other day I saw a Pullman car with half a dozen of the windows boarded up on the outside. The next morning I read in the newspapers: "Gas explodes under a car. Two men severely injured. In the New Jersey Central yards." I do not know that such an accident is usual, but they are now introducing the gas system on the New Jersey Central Railroad, and the plant which they set up cost them $75,000. Why this accident occurred has not yet been ascertained, but I presume it was not due to electricity, because there are no wires in the cars.

MR. MARKLAND: Do you say that was on the New Jersey Central Railroad?

MR. POPE: Yes, sir.

MR. MARKLAND: What manner of lighting do they use there?

MR. POPE: I think it was the Pintsch gas system, but these cars were Pullman cars.

MR. MARKLAND: That is something new to me. I had heard of no trouble from the use of gas.

THE PRESIDENT: I think we are all agreed, gentlemen, that gas is dangerous and obnoxious. (Laughter)

MR. DECAMP: As I take it, there is no question of the desirability of electric lights on the part of railroad companies; but it is simply a question of cost. I believe the railroad companies weigh very carefully the relative value of it. It is not that it lessens the cost in one case ten cents an hour, and gas costs five cents. They don't stop with that fact, but they stop with the considerations after having duly considered whether it is worth that difference, the safety of it and the comfort of it being given due consideration. We, as central station men, are all bothered with the idea of municipal authorities and private consumers that we are exacting from them an enormous price. My experience has been such that the time spent in trying to explain away those matters and convince the public that electricity does cost money, is wasted But when corporations like the railroad companies, who are working for their own interests, and are not trying to make money outside, or to profit from anything from the community, put themselves on record as stating the fact in the case, that they cannot afford to use the electric light solely on the ground that it is expensive, I think it would make more impression on the community as to the real cost of the article in which we are dealing than anything we might say in the matter. Therefore, when you get down to the pith of it the Pennsylvania Railroad company and all other corporations would certainly give electric lighting the preference, at least at the same cost of any other illumination.

MR. MARKLAND: I have no doubt of that. I might say, although I prepared this paper, that I do not speak for the railroad company at all. It is only my own observation.

THE PRESIDENT: I wish to say that all members of the association in attendance on the convention are heartily welcomed to the Narragansett station. Your button is all that will be necessary to secure your access to the department. We have been something of a pioneer in this field in constructing and designing a large station, and very likely have made some mistakes and must pay for our experience, as all pioneers have to.

The convention adjourned until 3 P. M.

AFTERNOON SESSION.

The president opened the afternoon session by reading the report of the committee on Underground Conduits and Conductors.

UNDERGROUND CONDUITS AND CONDUCTORS.

The committee on underground conduits and conductors announced that it had been greatly delayed in organizing for work, and had received only one company's report, that of the Chicago Arc Light & Power company, which follows:

Miles of duct occupied by high tension underground conductors, 28½.

Miles of lead covered cable in ducts, 79.

Miles of cable in iron pipe or bracketed under sidewalks for distribution, 72.

Total number of miles of underground high tension cable, 151.

Total number of cases of trouble on underground cable, 1890, 31.

Divided as follows: Result of mechanical injury, 18; result of defective joints, 4; result of defective insulation, 2; other burn-outs, causes not accurately determined, 7.

During the year 1890 33 8-10 miles of underground conductors were laid by this company. and during that period there was one case of trouble on this 33 8-10 miles, the trouble being in a defective joint. They further report that their rebates during the year for defective service amounted to one-third of 1 per cent. of the gross earnings; and they estimate that possibly one-third of these rebates are attributable to circuit trouble; the balance to defective lamps, dynamo and engine troubles and miscellaneous causes.

The longest underground circuit is 7½ miles from pole to pole, and carries an electromotive force of 2,500 volts.

They add that blizzards have not in any way affected their service.

The report concludes as follows: "The committee in offering this report realizes that the information is of a very meager character, but is of the opinion that if similar reports, or still fuller reports, could be had from all companies operating underground conductors, very interesting and instructive data could be laid before the convention; and they request that when questions are published and sent to various companies they will receive attention, and that the information required will be given fully and cheerfully by all those whom the circulars may reach."

The report was accepted, and the committee discharged.

THE PRESIDENT: The report of the committee on relations between manufacturing companies and central stations will be presented by Mr. Weeks.

E. R. Weeks read the following report:

MANUFACTURERS AND CENTRAL STATIONS.

The functions of this committee are almost defined by its title. The idea of, and the necessity for this committee is to have a recognized council for mutual conference and conciliation in case either a manufacturing or a central station company, should feel aggrieved by the business methods of those with whom they may have dealings, or be called upon to contend in business competition. In case of this kind the committee can take no action unless requested so to do by one of the aggrieved parties. No such appeal has been made to the committee.

This committee is also intended to represent the general interests of central station companies in case of unwarrantable competition in cutting prices for public lighting contracts, or to secure franchise rights in a town where a company is already in active operation and ready to perform all forms of service required at reasonable rates. Your committee is glad to state that no case of this kind has been brought to its notice since the twelfth convention. It has, therefore, not been called upon to use the influence of the association in that direction.

It is thought advisable to continue the committee as one of the standing committees of the association. The time may come again, as it has certainly existed in the past, when it will be necessary for this committee to exercise functions such as those indicated, or conduct negotiations of a different character under instructions from the association.

The recommendations of the committee were adopted, and the report filed.

DISTRIBUTION OF STEAM FROM CENTRAL STATIONS.

THE PRESIDENT: The next matter of business is a paper by F. H. Prentiss, on "Distribution of Steam from a Central Station." Mr. Prentiss is not present, and the paper will be read by Judge Armstrong.

Distribution of Steam from Central Stations

BY F. H. PRENTISS.

What has the distribution of steam from a central stations to do with electric lighting? This question can be answered much after the Yankee fashion of asking another. What have coal-tar ammonia, aniline dyes to do with making gas? These articles are by-products in the manufacture, which were once thrown away as useless, but which have now a value hardly second to the gas itself. Is it not true that the exhaust steam of electric light engines is a by-product in the making of light and for heating purposes. has a value scarcely less than the electric light itself? Since in a steam engine the amount of heat converted into work is relatively small, the value of the by-product or the exhaust steam is too large to suffer neglect. It is only a question of finding a market for it, and obviously this can only be done by a system of distribution from a central station. Will it pay to market this product? The answer to this question depends upon many complications and varied circumstances which in no two plants would be found alike.

The history of commercial electric lighting covers hardly a decade. The same is true of the sale of steam from underground pipes radiating from a central station. In both of these enterprises, frequent failures have been met with and many lessons learnt. I believe it is a fact, however, that all present existing steam companies more than pay expenses. A few have paid dividends while many have been obliged to re invest their earnings in improvements or remedying defects in original construction. The very few absolute failures have been due to faulty design, or defective engineering at the start. In the city of New York, two companies were started less than ten years ago, one of which, owing to faulty design failed and gave up business, the other known as the New York Steam company, is supplying steam for power and heating to nearly seven hundred consumers, and sells the product annually of more than 100,000 tons of coal burned under boilers aggregating nearly 20,000 horse-power.

In its distribution of steam through underground pipes the company has had many obstacles to contend with, the chief trouble having been the securing of absolutely tight joints. This difficulty has been completely removed by the method employed during the last four or five years as is well attested by the net-work of pipes on Madison. avenue and the adjoining streets between Fifty-third and Seventieth streets. where nearly three miles of pipe are in perfect operating condition and practically without a leak. The engineering difficulties which in an enterprise of this kind would strike one as more difficult to provide for, namely, the expansion of the pipes and the losses due to radiation were most perfectly provided for at the start, and therefore with the improvements which have been attained through practical experience of nearly ten years, the system has been brought to a state of perfection where in new work but little more can be desired. The pioneer work has been done and the electric lighting companies are therefore in a position to reap the advantages of the experience gained and to begin their work where the steam companies have left off, and can therefore feel certain in seeking a market for their by-product (their exhaust steam) to meet with no mechanical difficulties of construction.

The joining of two enterprises together such as electric lighting and the distribution of steam from central stations has both its advantages and its defects, and we must weigh one against the other. The electric light station is already in possession of its boiler house equipment, and for this reason has much less to charge up to the construction expense of steam distribution than a steam company, since its boilers are available for supplying steam directly to the steam mains, when light is not called for or when the engine load is at a minimum, and can furthermore by proper adaptation deliver the exhaust steam from the engine into the street mains, and for the purpose of heating recover the larger portion of the original heat value of the steam. Again in a combined plant the general expenses of management, superintendence and so-forth, need not greatly exceed the cost for the same items in a single plant alone. An obvious disadvantage is the increased back pressure put upon the engines. I am assuming of course that the engines are of a non-condensing type. The prejudicial effect of this back pressure is a subject which will well repay a little study.

Thirty pounds of water per horse power per hour is the recognized standard of boiler capacity, and is also a fair statement of the amount used by an engine of fair size exhausting into the atmosphere. A portion of the work of such an engine is spent in overcoming the atmospheric pressure of 15 pounds per square inch, and when, therefore, in addition to the pressure of the atmosphere an increase of back pressure is incurred, the useful work of such an engine is diminished by a corresponding amount. If this increase of back pressure is only that required for circulation of the steam for heating purposes the increased consumption for useful horse power per hour will not be greatly augmented in consequence, provided the pipes are sufficiently large and properly run.

The heating of residences by steam supplied from our Fifty eighth street station is often effected with steam at a pressure of one or two pounds. And it is well known that there are several systems in use where exhaust steam is applied for heating in a manner so as to make it possible to produce a vacuum in the heating coils. The back pressure of the exhaust, therefore, in a system where the engines discharge into street distributing mains, depends almost solely upon the size of the mains and the quantity of steam carried. A loss of pressure of 10 pounds in a half mile of pipe provides a carrying capacity reasonably in accordance with the cost of the pipe. Of course if this difference of pressure exceeds 10 pounds, the cost of transportation becomes relatively less, while the loss at the engine becomes greater, and vice versa in case the loss of head producing flow of steam is less than 10 pounds. This like many other details must be determined upon in each particular case. In order to illustrate this point I will present some calculations based upon a back pressure of 17 pounds, absolute (about 2.3 pounds ordinary gauge) with an initial pressure of 92 pounds absolute (or about 77.3 pounds ordinary gauge pressure). We will call this Case No. 1.

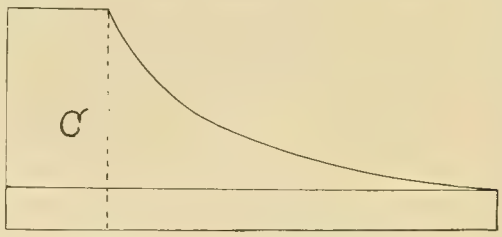
For Case No. 2. let us take the back pressure at 30 pounds absolute (about 15.3 gauge) and the initial pressure at 105 pounds, absolute (or about 90.3 pounds ordinary gauge).

In Case No. 3, let the back pressure be 105 pounds absolute and initial pressure of 180 pounds absolute. The last case is interesting, since it called for a theoretical consumption of steam per indicated horse power in an engine with an initial gauge pressure of about 165 pounds and a back pressure of about 90 pounds gauge. The diagram marked A shows the cycle of changes of steam used under the above conditions—omitting the practical considerations of wire-drawing, compression, early release, and so-forth, which are the interesting characteristics of an indicated diagram. The tremendous amount of unutilized work due to the excessive back pressure is clearly shown by the area of the rectangle $P_2 V_2$. In this diagram P_1 and P_2 are laid off as ordinates to represent the initial and back pressure, while V_1 and V_2 are laid off as abscissæ to represent the volume of 1 pound of steam before and after expansion. The expansion curve mn is supposed to follow the law $P V^{\frac{17}{16}}$=constant. The diagrams B and C represent cases 2 and 1.

At pressure P_1 (180 pounds absolute) Fig. A, V_1 of one pound of saturated steam is 2.49 cubic feet and at pressure P_2 (105 pounds absolute) the volume V_2 of one pound of saturated steam is 4.14 cubic feet. Neglecting all cylinder losses due to condensation, leakage, clearance, etc., and supposing the expansion curve to conform to the formula $P V^{\frac{17}{16}}$=constant, we have for the total work in foot-pounds of one pound of steam.

$P_1 V_1 \times 16 (P_1 V_1 - P_2 V_2) = 95{,}645$ foot-pounds. Deducting the work of overcoming the back pressure ($P_2 V_2 = 62{,}597$), we obtain $(95{,}645 - 62{,}597) = 33{,}048$ indicated foot-pounds, and as 1,980,000 foot-pounds per hour is equivalent to 1-horse power, it is evident that an engine working under conditions above named would require $\frac{1{,}980{,}000}{33{,}048}$ = 60 pounds of water per horse power per hour.

In a similar manner it may be shown that between the limits of pressure 90 pounds (105 pounds absolute) and 15 pounds (30 pounds absolute) there would be required 26 pounds per indicated horse power per hour. This covers the case of an engine exhausting into low pressure street-mains.



An engine exhausting into the atmosphere with 2 pounds back pressure (17 pounds absolute) and receiving steam at 77 pounds (92 pounds absolute) would require 19.7 pounds of water per horse power per hour.

In actual practice the losses due to clearance, wire drawing, incomplete expansion, cylinder condensation, etc., would have to be added to the amounts above given.

If in the last case (C) we add 10 pounds, making about 30 pounds per horse power per hour we shall have an average practical result as obtained from automatic single cylinder engines of fair size.

The great loss due to cylinder condensation is largely dependent upon the difference of temperature between that of the steam at admission and that at exhaust. In cases A, B and C, this difference is respectively 42 deg., 81 deg. and 102 deg., and hence with the same size cylinders in each case it is quite sufficient to make the same allowance of not more than 10 pounds additional for B and C, making for B—about 37 pounds per horse power per hour, and for C 70 pounds per horse power per hour.

Now in an engine operated in such a manner there would be during expansion a loss of heat due to conversion of the internal energy of the steam into work amounting to

$$\frac{16 (P_1 V_1 - P_2 V_2)}{77^2} \quad \frac{31{,}104}{772} = 40.3$$

thermal units per pound of steam, which would produce a condensation amounting to 3.3 per cent. The total thermal units (above 32 deg. F.) per pound of steam at 105 pounds (absolute) pressure is 1,182.4 or $(1{,}182.4 - 181) = 1{,}001.4$ above the temperature of the feed water (212 deg. F.). Hence the available heat in the exhaust would be $1{,}001 \times .987 = 968.35$.

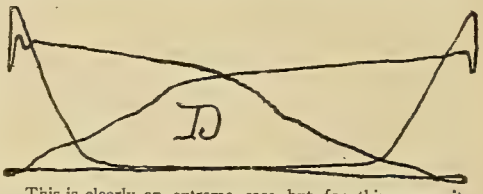
Before entering the cylinder, however, the steam at 180 pounds (absolute) contained $(1{,}195 - 181) = 1{,}014$ thermal units per pound above the temperature (212 deg. F.) to the feed water. Hence the total loss due to conversion of heat into work is 4½ per cent.

In addition to this loss in the cylinder of the engine we must consider a further loss at the boilers owing to the fact that by raising the pressure we have increased the temperature of the steam 42 deg.

Now assume that the increase of the temperature of the escaping gases amounts to 42 deg. (and it certainly can be no greater) and allowing 24 pounds of air per pound of coal, we have $42 \times 24 \times .238 = 240$ thermal units lost per pound of coal burned.

Now assuming that one pound of coal evaporates at 105 pounds pressure (absolute) 8 pounds of water which is equal to $(1182.4 - 181) \times 8 = 8011$ thermal units. The loss at the boilers, therefore, may amount to $\frac{240}{8011}$ = about 3 per cent. Adding this to the previous loss of 4½ per cent. we obtain a total loss of 7.5 per cent. But this loss must be figured on a basis of 70 pounds of water per horse power per hour, and hence when computed at 30 pounds becomes 17.5 per cent.

Therefore we have practically obtained our work in the high pressure electric light engines at the rate of five and a quarter pounds per indicated horse power per hour, the re evaporation during exhaust, together with the unbalanced motion of the steam due to eddies, wire-drawing, etc., appearing again as steam or useful heat in the street-mains.



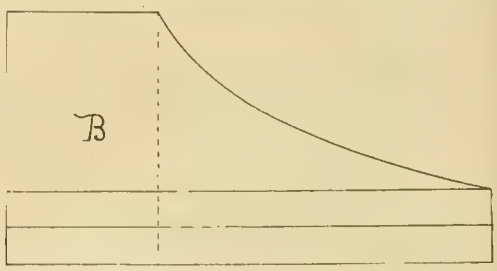
This is clearly an extreme case, but for this reason it better serves as an illustration. The percentage of steam condensed to water through the conversion of heat into work during expansion would be greater in cases 1 and 2, but in these cases it would hardly be necessary to consider any possible extra loss at the boiler.

Diagram D is the representation of an indicator card taken from an engine operating under conditions of excessive back pressure similar to case No. 3, Diagram A. The back pressure in this instance was about 55 pounds above atmosphere and the initial pressure about 130. The engine was an automatic cut-off type taken from the salesroom of a well-known engine builder, having been built for ordinary duty and not especially designed or altered for work of this unusual character. The engine was directly belted to a 750-light A. C Westinghouse dynamo, which supplied current to about 600 incandescent lamps in the Lenox Lyceum, Fifty-ninth street and Madison avenue.

The building was wired throughout on the three-wire plan and the converters were arranged two in series with a middle wire to suit these conditions. The plant was supplied with electric meters and the various station instruments, and represented, therefore, on a small scale, a central electric light station. The exhaust pipe of this engine was directly connected with our street mains where an average steam pressure of about 55 pounds was always maintained. The steam from the street mains was used in part for operating elevators in apartment houses, and for running engines and in part for heating. If we follow the steam in its course through the electric light engine, thence through the elevator, engines and pumps and other engines along the line of the underground steam mains and thence to the radiators where condensation takes place, it will be evident that an economy is attained similar to that in a compound condensing engine, the electric light engines playing the part of the high pressure cylinder, the other engines playing the part of the low pressure cylinder, and the radiators taking the place of the condenser.

This engine was operated under these conditions three or four evenings a week for about a year, affording a perfectly steady and satisfactory light from the incandescent lamps. The running of the engine was not attended with any special difficulties and gave no more care and occasioned no more trouble than if exhausting into the atmosphere. On several occasions the exhaust of the engine was shut off from the street mains and turned into the atmosphere, the initial pressure being reduced at the same time to correspond. At other times the reverse of this change was effected, and the exhaust turned from the atmosphere into the street mains without in either case producing a noteworthy fluctuation in the light from the incandescent lamps.

The gross revenue to be derived from the sale of steam for the heating of buildings may be estimated at from $2.50 to $5.00 per thousand cubic feet of space heated per season. The amount of heating to be obtained per mile of street mains will evidently vary very much according to locality and in the dozen or more district steam companies, it is interesting to note what this variation is. In smaller towns where systems of underground steam distribution exist, the space heated seems to vary from 1,000,000 to 2,000,000 cubic feet per mile of street main and in the case of a larger city reaches 5,000,000, and in the city of New York exceeds 15,000,000.

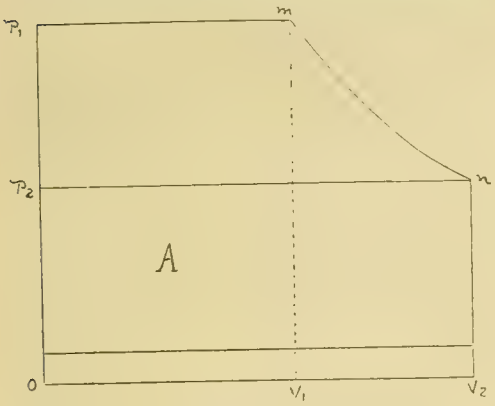


The cost of plant (which in these figures includes boiler-house and boilers), varies from $20,000 to $30,000 per mile and in one instance reaches $50,000.

In New York City the cost very much exceeds these figures, owing in part to the difficulties encountered and in part to the fact that the street mains were laid with a view to supply steam for power. In the New York plant the pressure of steam in street mains is above 80 pounds, and furnishes a supply to over 500 engines, and requires for this purpose in the summer time about 250 tons of coal daily, and including heating reaches 500 daily in winter.

The cost of plant is greater in cases where steam is furnished for power as well as for heating. The actual cost of a district steam plant, where the business is confined to heating alone, seems to vary from $10 to $20 per 1,000 cubic feet of space heated. Here again this cost includes boiler-house and boilers.

In order to make it clear beyond dispute that the business of a district steam company can be added to that of an electric lighting company without prejudice to the latter, two points only need be established. First, the possibility of utilizing the exhaust of electric light engines without detriment to the light, and without introducing any serious complications or expense in the management of the station. Second, the certainty of an extra revenue, the net profits of which will equal or exceed the profits from the lighting plant for equal amounts of money invested. I have already touched upon both of these points and need, I think, only refer to the practical working of the combined system at the 58th street station of the New York Steam company, where the back pressure of the engine was 55 pounds (with no inconvenience and with no extra expense, save an almost indeterminate increased consumption of fuel) to prove that with a back pressure of only 15 pounds a practical mechanical success is assured. Of course to get the same power from the engines, it would be necessary unless previously running with a light load to increase the initial pressure 15 pounds or to the same extent that the back pressure is increased. The effect of this, as I have shown, will be merely to pass a little more steam through the engine per horse-power which ordinarily would be a bad practice and a waste of fuel, but when distributed and sold for heating purposes has nearly the value of live steam taken direct from the boiler. There would be times of course when the demand for heating would be slight and when therefore it would be more economical to use a free exhaust, or where there were several engines to have only a portion of them deliver their exhaust into the street mains. The experiments of the New York Steam company, previously cited, showed that the engines could easily be shifted from one exhaust pressure to the other without detriment to the light, and it therefore be easily possible to secure at all times a max



mum of economy which a combined system would permit. So far as profits and dividends are concerned a very considerable saving would follow by the mere union of the two interests without even taking into account the value of the exhaust steam. Since, however, so much is dependent upon local conditions it is impossible to give figures which would apply to anything more than a hypothetical case. The amount of heat lost by radiation from the pipes of the New York Steam company showed the loss to be about 3 per cent. of the carrying capacity of the pipes. It may be well to add here as having a most important bearing on the profitableness of such an investment some of the details of the cost of underground steam work. The sizes of pipe most common in practice are those having diameters of 4 in., 6 in., 8 in. and 10 inches, the carrying capacity of which with steam flowing with an initial head of 15 pounds, are respectively about 50-horse power, 150-horse power, 300 horse-power and 600 horse-power. The cost of the underground construction, which includes valves and the special appliances such as variators, service boxes, anchorages, insulation, etc., may be roughly estimated at $7.50 per foot for the 10 inch, $6.00 for the 8 inch, $4.50 for 6 inch and $3.50 for the 4 inch. In many instances where large buildings adjoin the lighting station, many of the appliances may be omitted and much of the expense spared which must usually be counted in the cost of long distance work.

The average price received for steam from the aggregate of consumers large and small is somewhat more than double the cost of producing the steam at the boiler house. This average price is one willingly paid by the consumer, owing to the saving in cost of labor and to the many conveniences and advantages to be derived from having steam on tap like gas and water. Out of these gross earnings, which exceed 50 per cent. of the receipts, there must be subtracted the cost of maintaining the street system, leaving a balance applicable either for dividends, improvements or new constructions, or as often is the case in new enterprises this balance must be expended in reconstruction made necessary through defects arising from lack of experience at the start.

The entire annual gross receipts of a plant are, of course, limited by the carrying capacity of the pipes and may be estimated at about 40 per cent. of the cost of construction, and therefore net earnings of 25 per cent. will permit of 10 per cent. dividends. Since the cost of steam amounts to fifty per cent. of gross receipts, it is evident that if one-half of the steam sold for heating can be obtained from engine exhaust the saving effected in this way alone will amount to enough to pay a ten per cent. dividend.

In this paper I have attempted to show the complete practical and commercial feasibility of combining a system of steam distribution from a central station with an electric light plant in a manner to utilize the exhaust.

I have given data that will assist in investigating the value of the plan in any locality where heating by steam could be introduced, but have purposely omitted to give any description or details of mechanical appliances and construction of underground steam work, as it seemed to me that the more important issue for discussion was the question: What has the distribution of steam from a central station to do with electric lighting?

Discussion.

Dr. R. H. Bishop: It may be said that the combination proposed, the use of exhaust steam from electric plants, is of a few years' development only, for the reason that electrical plants themselves are of very modern origin. The especial subject before you now is the practicability of electrical and steam combinations. Your attention has been especially called to the utilization of exhaust steam from your engine and the natural inquiry is as to its effect upon your engines and boilers through back pressure. The author of the paper just presented has shown that there is no theoretical reason why this cannot be done and supplements his reasoning with reports of his own practical experience, and to those I am pleased to add reports of others' experience. The American District Steam company constructed a short line of street mains in the fall of 1889 for the Edison Electric Light company in Kansas City. In the fall of the same year the Ottumwa, Iowa, Railway, Electric & Steam company, in addition to extensive street railway and electric lighting plants had over two miles of street mains constructed to work in connection with their other interests.

Another illustration of this use of exhaust steam can be quoted from the Springfield Electric company. This pipe was laid last fall. The steam is delivered through nearly 2,000 feet of mains at two and three pounds' back pressure. The company are so pleased with this saving of exhaust steam that they propose an extension of the mains the coming season.

Another similar undertaking was made by the Duluth company last fall. I had not seen them to obtain details. There is another plant at Chester, Pennsylvania.

Thus far we have viewed this exhaust steam as a by-product—that is purely as referring to electric light plants. But may we not hereafter refer to it as the original commodity? You buy real estate, erect buildings and boilers, lay railroad tracks, equip with motors and cars, buy coal and water, employ a force of men; yet it is all a useless aggregation until you fire up the boilers. By combustion of fuel and absorption of the heat units of water, we load this water with the full value of our product, and do you utilize all by former methods? That is your important question. I believe it is conceded that the average engine makes use of only about ten per cent. of the heat absorbed. The balance has heretofore made its escape. Like the compound engine to which Mr. Prentiss makes comparison we propose to exact further duties from this power which we can if we turn it into the street main and heat our buildings as well as light them so that when the water becomes water again it has contributed its full value of heat absorbed to the investment.

You naturally ask about how much value has this steam. An approximate answer may be given by stating that each hundred horse power of boilers steaming at twenty to twenty-five pounds' pressure has a capacity for heating one million five hundred thousand cubic feet of space. This is the maximum. The minimum figure, allowing for all absorption of heat by engines is one million cubic feet for each one hundred horse power.

Another important question in connection with this general subject is that the earnings from electric light plants is confined from six to eight hours out of each twenty-four. The balance of the time the boilers and men are comparatively idle. Instead then of banking your fire from sixteen to eighteen hours waiting for the time to come to commence earning again, keep all steadily at work at low pressure supplying heat. It costs but little more to run the boilers, engines and other machinery lying still at fifteen or twenty pounds than to bank the fires and hold them at the higher pressure without use. The heaviest load in heating is during the hours that the electric work is lightest.

This whole subject is finally reduced to this suggestion: Add the steam heating to your other industries that you may get all that is possible out of your plant by working twenty-four instead of six or eight hours, and especially to get out of your steam all the value that it contains instead of being satisfied with a small percentage only. These are the fundamental principles of success in any business. Is it not apparent that this subject has something to do with electric lighting?

A. L. Ide: Last fall we put in about two thousand feet of main, about one-third of eight inch, the balance six inch. Our station is favorably located in the central business portion, and we conceived the idea of selling our exhaust steam. We have a five-year contract for furnishing power for an electric railway. At present they are running ten cars. We also run a motor circuit that is now using about fifty horse power. We made a contract with seven store buildings to heat them for five years with exhaust steam at a price averaging about two hundred dollars a year. The buildings contain about 100,000 cubic feet of space each. We did not contract for any more at that time because we wanted to be sure to have sufficient exhaust steam to supply them. We have now given about four months' service which haa been very satisfactory in every respect, heating the buildings satisfactorily in the coldest weather. We never have exceeded four pounds' back pressure. Ordinarily we carry two pounds back pressure, and the gauge shows a reduction of about one pound at the extreme end of the mains. We estimate that the expense of furnishing this exhaust steam is trifling. We do not notice any difference in the consumption of coal required, and we now find that with the surface exhaust steam we do not utilize over half. Next summer we expect to add about a thousand feet more main. We think our present steam will be sufficient to double our capacity. We estimate that the receipts we get from steam are about one-half profit. It does not require any additional attendance. It is simply the interest on the investment on the plant, and the slight additional fuel it requires.

Ralph W. Pope: In connection with this subject it is interesting to note that it is a reversal of the proposition that was made by the New York Steam company some six or seven years ago to utilize their waste steam at night for electric lighting—I think in connection with the Parker system. I never heard anything more of it, excepting that it was a newspaper statement in which they gave interviews with steam heating people, and some others, as to the practicability of it.

John A. Seely: I would like to ask if in utilizing this exhaust steam whether the exhaust is confined to a boiler or cylinder before it is forced out into the main; also whether the mains are inclosed in any special jacket to prevent the steam from escaping or expansion of joints of any kind—whether they have had any tronble whatever.

Dr. Bishop: The connection is made direct with the exhaust pipe—no drum, simply a continuation of the street main. The exhaust pipe goes direct into the main

There is a very elaborate system of covering, of protection against condensation, and a provision made for expansion and contraction of iron. It is known as the Holley system. The drawings I can show you at any time. This point is only attained by having accomplished those two points—not losing our steam by condensation, and being able to control the iron under expansion and contraction. I say it is known as the Holley system, which I shall be glad, whenever you wish to see it, to show to you.

The President: The next paper on the list on the Municipal Control of Electric Railroads has not been presented. Following that is the report of the Committee on National Insurance Rules.

Mr. Francisco: The committee has accomplished nothing, and it has consequently nothing to say.

The committee was discharged.

The President: I recommend that a standing committee be appointed to formulate, and from time to time, revise a code of instruction to be known and published as instructions for the safe and economical wiring of streets and buildings for the service of electric light and power, and for the proper inspection and maintenance of the same. The recommendation was approved, and the chair was authorized to appoint the committee.

The convention then adjourned until Wednesday, at 10 A. M.

Wednesday's Proceedings.

The convention was called to order by the president at 11:10 A. M.

The President: It seems eminently proper that we should pause a moment in our advancing course, like a traveler ascending a mountain side, to look back upon the path he has already traversed. There will be many things of interest, and many things to remember that are gay and some that are sad, for they are not all with us who started out in the morning of our work.

There are those here who represent the ocean cable and the overland telegraph and telephone, which has enabled two continents to converse together, the inhabitants to hold familiar intercourse with each other; those who witnessed the first division of the electric current and saw the glow of the infant incandescent lamp: those who witnessed the first uncertain sputter and flare of the arc lamp in its early state; those who by their energy and perseverance have dotted the country all over with the little stars of the incandescent or vacuum lamp and the sun-like brilliancy of the arc light, until they vie with the firmanent above us The transmission of this mysterious energy by the hundreds of horse power over a little conductor no larger than our grandmother's knitting needle, to revolve the wheels of our industrial establishments, and propel in all directions vehicles for the transportation of passengers and freight.

These are only a few of the triumphs which have attended the development of the industry which we represent, but it is not my desire to entrench upon the time which belongs to you. I wish, however, to relate a single instance of my experience. One of the first duties which came to me as manager of the Narraganseett Electric Lighting company was the laying out of a new circuit.

When I first came into the Narragansett company, six years ago, Mr. Thomas had just been appointed superintendent and the first duty we had was to lay out a new circuit within two or three days after we came together. He was somewhat new to the business and I myself but little acquainted with it. We thought we would draw it out on paper, and we looked down this street and back again into this building and out again and it was a very crooked affair, and I said; "Thomas, this will never do. We know electricity is not going around those corners; it is going to fly right off the angle of the wire, straight to the ground and go into the buildings." He said, "No; when I was working for the burglar alarm system we used to coil the wire on a pencil and I think the idea was to give it a whirling motion so that it would go around these corners." So we put out the circuit crooked and it worked ever since.

Judge Armstrong read the letters of regret from H. H. Bigelow, Worcester; Charles F. Brush, Cleveland; Cyrus W. Field, New York; Norvin Green, New York; George G. Ward, New York; Alexander Graham Bell, Washington; and Prof. Cross of Boston.

The Telegraph and Telephone.

Mr. Lockwood: It seems to me in order at the outset of my remarks that I should offer what the newspapers call a word of "personal explanation." I never have been fond of following fashions, or I think I should have written a letter. I did not know until my arrival here that Dr. Norvin Green had not been able to appear. I knew that Prof. Bell had been unavoidably detained in Washington, We have it on no less authority than the immortal Shake

speare, that "imperial Cæsar, dead, and turned to clay, may stop a hole to keep the wind away." This quality I apprehend is the only one which Cæsar and I share; that is the only parallel between us.

The telegraph of to day is about fifty-five years old. Prior to that there were numerous conceptions, numerous imaginative notions, but nothing practical. Almost from the earliest years of the Christian era, or, at all events, dating far back in the Middle Ages, there has been a conception prevading the literary portion of mankind, of what I may call the imaginative telegraph. This appears first in a Latin book written by a monk, and the conception briefly stated is that of two needles poised upon pivots and pointing to the periphery of a circle around which there were depicted the letters of the alphabet. It was said that if these two needles, which were of iron, were rubbed upon the same loadstone that two friends might then take them and travel in opposite directions, and at stated times if wishing to communicate with each other one of them by pointing the needle to the various letters of the alphabet, the needle in the hands of the other one would promptly respond and point to the same letters, and by that means conversation between the friends could be readily carried on.

This I believe was the first imagination of what has since proved a grand reality,—the dial telegraph. It has formed the subject of story and song. Joseph Addison speaks of it in his essays, and our old friend Galileo, who, although an ardent philosopher and a great scientist, was also a keen man of business, tells us in one of his stories that a certain man came to him and offered to sell him such a thing, and he said "I do not care to buy it until I have first tried it to see whether it will work." The person then declined to put it to a test, and Galileo said to him "I do not care to go into the uttermost parts of Muscovy simply to try an invention I know will not work," and he asked him to sit down with him on a sofa and see if it would work, because he knew if it would not work for a short distance it would not work for a long one.

As years rolled on electricity came to the front, and it was seen the only way by which intelligence could be sent for a long distance was through its agency. Before the right plan came to the front several hundred wrong plans naturally came there. But had it not been for the invention, in the beginning of this century of the voltaic pile I do not think we should have seen the electric telegraph, because that was the early beginning of magnetic electro induction, and if we had not had the pile we certainly should not have had the dynamo.

But after that, in 1819, another real advance was made, another advance which magnetic applications of all kinds and to which voltaic electricity owes its industrial application, was made. This was the discovery in 1819 by the Danish professor, Oerstedt, of the missing link between electricity and magnetism. I do not hazard anything when I say that to that one discovery everything that we now do by electricity is due, except perhaps, what I think are the neglected arts of electro-plating and electro-typing; since, as early as 1832, at least, our own Professor Morse, whom some of us have seen, and whom all of us have heard of, conceived when he saw and witnessed the operation of electro-magnets, that the electro-magnet was the means through which electrical communication was to be devised. He came, he saw, but he did not conquer for at least five years from that time. In 1837 his first model was made, which by 1842 was put into practice. The early line, as many of us know, was from Washington to Baltimore. The first message, which was sent by the daughter of Commissioner of Patents Ellsworth, was: "What hath God wrought." From that line nearly every line in foreign countries has proceeded. In this country we are apt to state that Morse is the inventor of the telegraph. We should say that he was the inventor of the electro-magnetic telegraph.

From those small beginnings what has arisen? This country is covered with lines from side to side and from one end to the other. The entire civilized world is covered with electric wire. The continents are linked by under-water cables. To-day the business man conducts his business by electricity.

I would have liked that the ancient chronologist, the great sage of telegraphy to-day, the man who stood by Morse in his earlier years, J. D. Reid, was here. His name was brought to my memory by the incident which your president has related of the electrician who persisted in winding his wire around a pencil to overcome certain defects. I was reminded by that of the great faith which some of the early superintendents had in Reid. It appears that he had always been accustomed to roll up his record at the end of directors' meetings. but one eventful meeting he was absent. Mr. Swayne presided over that meeting, and at its close the secretary pro tem. proceeded to fold up his records, when Swayne grasped him by the arm and said: "Stop, Reid never does that; Reid always rolls them." And the records were rolled. It is very difficult for me to speak at length upon this subject; but I should not do you or myself justice were I not to mention, for a moment, one or two of the later inventions which have made the telegraph what it is. If I should neglect to speak of the various methods of multiplex telegraphy, of the duplex telegraphy, originated, I think, in the first place by Dr. Gentil, of Germany, persevered in and at last perfected and made a practical agent of civilization by our own J. B. Stearns, a Boston man, I should feel that I had neglected my duty. Just about six months before Stearns did make it practical, one of the ablest electrical historians of Great Britain wrote a very capable, able and intelligent text book of electricity as applied to the telegraph. The first part was composed of history, the second part of descriptions and of apparatus, but one of the most remarkable things in that book, and one of the statements which will make that book immortal, is this. After describing the various methods, he said: "But all these things are simply series of electrical gymnastics, but which will never come to any practical account." Six months after that the duplex was working on the lines of the Franklin Telegraph company in the United States and making that company a formidable rival of the Western Union. A very little while after that it was seen that if it were possible to send two messeges in the same direction over the same wire, if it were possible, as it had proved to be, to send two messages in opposite directions, it might then be possible, as a third stage, to put the two together and make a quadruplex. This was demonstrated by Oliver Heaviside, in England, and was put in practice by Mr. Edison and Mr Prescott on the Western Union lines. It was seen that the Morse telegraph—the manual operation of the Morse key—took up a great deal more time than was necessary, and that a wire was capable of a great many signals in a given unit of time, more than the individual arm was capable of sending upon it; and one or two men argue that if this be so we may cut up the ends of our wire into perhaps, four, eight, twelve, sixteen different branches, and each branch should have possession of the entire main line for its individual moment. Then as the operator on each branch could send up to a certain rate, if we did not have a larger number of branches than the aggregate number of pulsations which all the operators were capable of sending, it might be possible in that way to send a large number of messages in either direction upon the same wire. The great difficulty was that it was not easy to make the moving end of the main line at the two terminal stations move synchronously with each other; they had a habit of running one a little faster and the other a little slower, and very soon the two operators were working with people with whom they had no concern. And so the great point for the inventor was to keep the main lines in synchronism. This was practically done by a man who had grown up as a telegraph operator, Patrick B. Delany, Providence is the place where of all others I should speak of this, because for a long time the practical line worked upon those principles was operated between Providence and Boston,

The British government has, as you know, control of its telegraph system. They like to stick to the old ways over there, perhaps, more than we do in America, and yet that conservative government has seen fit to purchase the Delany invention, and I saw it in operation last summer, when six messages were being sent over one line; and the British government is satisfied with it, and it is doing excellent work there, side by side with the Wheatstone automatic.

I do not feel that I have done justice to the telegraph. I am, however, a little more at home upon the next branch of my subject—the telephone. Sir David Brewster, one of the greatest scientific men of a scientific age, and who died about twenty-four years ago, was a Scotchman who for many years was at the head of scientific circles in England. More than once he was president of the British association. He wrote a book some time between 1830 and 1840 entitled "Letters on Natural Magic," and he closes a chapter devoted to automatic talking machines by saying "We have no doubt that before another century is completed a talking and a singing machine will be numbered among the conquests of science."

That book is most interesting and was published in 1832. It is not an easy book to get, but I had reason to believe that I should discover there what I did discover, namely, a chapter on talking machines. It is at least two hundred years since talking machines have been in experimental use—I mean automatic concerns, which could be made to utter certain words, usually of a very low order; something like the words uttered by the phonograph dolls; and if you knew what those machines were going to say it sounded wonderfully like. They could say "Papa" and "Mamma" and usually their vocabulary ended there. Whatever words those machines were constructed to make those words they would make, and the mechanism was of a most complicated character because their makers assumed that to copy vocal articulation they must necessarily copy the entire human mechanism, including the mouth, the larnyx, the wind pipe, and so forth. I have often wondered that some time in reality some one has not tried to do what Frankenstein tried in story to do, make an entire human being. You know, he did construct a human being, but he couldn't make it the right size because he could not work on a sufficiently small scale, and when he got it built it was such a terrible thing that it frightened him and became the grief of his life.

Justice Sprague, one of the great lights of the legal profession, gave utterance to the following statements: "Prophecy after the event is easy prophecy," but this was prophecy before the event and is realized. Sir David Brewster's prophecy was not after the event, and it was not easy, but it was made by a man of science through the faith that was in him generated from what he had seen and from what he knew of scientific laws. At the time when Brewster spoke certain automatic machines had from time to time been made which laboriously imitating in their construction the human vocal organs were able to repeat one or two words; but the machine which realized his prophecy employs as its talking organ simply a little disc of metal. In the telephone a double problem was solved, which was, first, how to make a metal plate copy the motions of all complex organs of speech; and, secondly, how to make that one plate talk by electricity when that electricity was applied at a distance. In other words, if the person should be talking here, how shall he make an iron plate copy his talk somewhere else and reproduce it? There was one man of all the world fitted by education to do it, and that was Alexander Graham Bell, because his father had from the earliest infancy of the younger man been a professor of visible speech. His profession was to teach dumb people to talk, and the younger man followed in his father's profession; and it was that profession which led him to teach a dumb girl in Cambridge to talk; and it was that profession which led him into the way to make iron plates talk, which was, as Sir Wm. Thomson puts it, into classical language later on, that if we would make anything talk at a distance, if we would transmit speech electrically, we have to realize "the mathematical conception that if electricity is to convey all the delicacies of quality which distinguish articulate speech the strength of its current must vary continuously, and as nearly as may be in simple proportion to the velocity of a particle of air engaged in constituting the sounds."

That was the underlying discovery which made the telephone a reality, just as the invention of the condensation of steam by Watt made the steam engine a reality.

Prior to 1876 we had not many industrial applications of electricity. Probably eighty per cent. of the persons interested in it were engaged in telegraphy, and the remaining twenty per cent. was divided between instructors of youth and persons engaged in electrotyping and electroplating. I think we should do all honor to the men who, largely by rule of thumb, it is true, carried on some of the grandest uses of electricity from almost the invention of the Voltaic pile in 1800 until the present time, without knowing much about it, without any literature on the subject, with only five text books up to the present time which touch upon it at all, and yet who made that business a success.

All that is changed. The civilized world glows with the illumination of electricity; the electric motor is abroad doing our work, and the long suffering car-horse and mule are at last encouraged by the application of power to street railroads to believe that the day spring has visited them; while five hundred thousand telephones in the United States, and as many more in other countries, attest the fact that people will and must talk.

I wish to say that all of this work which has been done is attributable to two things: a quality and a practice, enterprise and experimentation. There is no lack of the former in the United States, but I fear that we do not as yet fully appreciate the latter. It is impossible that I or any one can ever estimate the value of experiments.

Those of you who have studied the story of electricity and its triumphs well know how it was experiment that guided Oersted to the missing link between electricity and magnetism; which gave Davy the honor of discovering electrical illumination; which enabled Faraday to patiently fish out bit by bit the pieces of the puzzle composing the one department of electricity, which more than all others has made electrical illumination, traction, and oral communication living realities—magneto electric induction.

It was experiment that enabled Spencer, Jordan and Jacobi almost simultaneously to discover the art of electrotyping; and the Elkingtons with their associates about the same time to introduce electroplating; arts which useful from their inception have now become ornamental also, and which have put into the hands of true artists a ready means of reproducing the beautiful in a surpassingly beautiful way. It was experiment that carried Bell to the invention of the art and apparatus of telephony; and Thomson to the art of electric metal working.

And looking at the other side of the case, it is equally certain that it is the neglect of experiment which is our means of conversing with Nature, asking questions of her and receiving her replies and the neglect of reasoning based on experiment, which prevented electricity from advancing a single inch for the first 2,000 years of its history, from the time of Thales, the Ionic philosopher, to the time of Gilbert, the Elizabethan sage; the founder of electricity as a science.

We have heard it said that speech is silvern and that silence is golden; and the recorded opinion of that great and ancient patron of Mormonism and Masonry King Solomon is that a word fitly spoken is like apples of gold in pictures of silver; so we see that even on the subject of speech there is room for two opinions, but that the telephone was and is an immensely valuable adjunct to the American style of doing business, in which time is held to be a commodity of great value, none can doubt.

It is now used over lines of lengths varying from a few yards to several hundred miles, and as a labor-saving machine, has proved its right to exist.

Whether it will ever be available for long submarine cable work the future only can tell. All the conditions of the case indicate that it will not; but who can limit the possibilities of the future after so many apparent impossibilities have been achieved! Such a possibility was contemplated even before the telephone itself had appeared.

On December 29, 1868, at a banquet tendered to Prof. Morse the British minister, Edward Thornton, in responding to a national toast made this remarkable utterance: "Should I have the good fortune to live to the age of the venerable professor, I still hope to see some such improvement as will enable us to carry on a viva voce conversation by means of the cable. We shall then have merchants on this side of the water discussing their affairs with those of the other at so much a minute. We shall hear perchance of some love stricken youth of London or Paris whispering soft nothings along the cable to a bewitching siren of New York or Providence at so much an hour, she tempting him, Leander-like, to throw himself into the gulf which separates them. We shall then have a statesman, and in these days of progress, possibly stateswomen, discussing international questions at so much a conference, and diplomatists will run a very good chance of being exploded altogether."

I have always wondered that somebody has not set Sir Edward up as an anticipatory inventor of the telephone.

We find in Holy Writ that when the prophet stood on Mount Sinai the manifestations of the proximity of the Divine presence were successively a strong wind, a fire, and a still small voice, and I rejoice to-day that the still small voice has been found worthy of being asked to take part side by side with the fire and the earthquake and the hurricane.

THE PRESIDENT: I have the honor to introduce to you now one with whose fame and whose works you are all acquainted, and of whose achievement we are all of us proud. I speak of Prof. Elihu Thomson, the man whom I believe to be the greatest living electrician.

LIGHT AND POWER.

PROF. THOMSON: I suppose I am to be called upon to-day to represent the fire, the earthquake and the hurricane. I feel that the vastness of this representation

is appalling. I will do a little toward such representation, but I will make it rather mild, so that you need not fear the fire, the earthquake or the hurricane.

We are here to celebrate the completion of the first ten years of the great industry of electric lighting—great now, but ten years ago very slight indeed. We are here also to recall circumstances, to recall incidents of our early experience in this industry and kindred industries. I will begin by recalling a few circumstances which happened to me in 1889 and which made a lasting impression. It was my privilege to visit the Royal Institution in London and there inspect the original manuscript records made by Sir Humphrey Davy and by Faraday—the two great names lying, as it were, at the foundation of the sign, at least, of electric lighting,—to inspect also the apparatus and even to handle the apparatus which Faraday used in his early experiments. I can say that I did it reverently, undoubtedly. These two names are coupled with the beginnings of our great industry. Sir Humphrey Davy was the first man who ever saw the electric arc; the first man who put two wires together tipped with carbon, drew them apart and got the flame which we now call the electric arc. He called it the electric arch, I believe, or an arch of flame. I saw the record of this original inscription, and the inscription in Davy's rapid hand that this was a gorgeous experiment. He did not, apparently, realize what it might come to as a gorgeous industry, as a splendid industry, to be established, to flood the world with artificial sunlight, to utilize the stores of energy which are in the bowels of the earth—taken out, put under the steam boiler in the form of coal, chemical action allowed to produce heat and finally to produce electricity, and, as it were, turn back upon us the radiant energy of the sun. That is what we are doing. I say he did not realize that probably; but he simply admired the experiment from the scientific standpoint. His enthusiasm was that of the scientist, and it is a worthy enthusiasm in all cases. The scientists may discover something which may not, at first, have the slightest connection with practice, but sooner or later, no matter what the idea, no matter what the discovery is, whether small or great in a scientific sense, I have full confidence that the time comes eventually when such discoveries are utilized in practical life as this discovery of Davy's was.

It was quite a contrast—the difference between Davy's style of recording his experiments and Faraday's—and there is that contrast even to be seen in their work. Davy was, as it were, brilliant, jumping from one thing to another and getting thereby a great leap; while Faraday's was the painstaking work of the scientific investigator who thought out carefully what he was about, and when he had concluded his experiments, wrote out just as carefully what he had obtained. The records of Faraday's are models of neatness; they are models of precision in every way. I recall this as a reminiscence. It is a late reminiscence, but it carries us back to the time when Faraday was at work in the discovery of the action of currents in magnetic fields. It is to Faraday that we owe the discovery of the principle which underlies the generation of current by the dynamo. It was he who moved armatures in magnetic fields. It was he who found that the magnet was capable under proper conditions of yielding currents. He was perfectly satisfied to investigate that fact and the condition under which it occurred, and he expressed his confidence that the time would come in which these facts and principles which he was investigating purely from the scientific standpoint would be applied on a large scale in practice. He said it was not for him to do that, however; there were others who would take up that work.

Coming down to more recent periods after these investigations, we find, occasionally, efforts made to employ these principles in procuring light, and one of the earliest was the running of a lighthouse by a magnetic machine constructed in accordance with the principles which Faraday discovered; but it was a solitary instance for quite a number of years. Then came upon the scene M. Gramme with his wonderful dynamo and machine, the elements of which were known before, in fact, were known when Faraday made his experiments and published them, were known in a crude way in other prior types of machine. In fact the very principle on which the Gramme dynamo was founded was well known, but the construction of the machine was unique, and it was afterward found, indeed, that this construction was, in the literature, due to Pacinotti, an Italian professor, but it had rested in obscurity for a number of years. Gramme, however, constructed a machine which would produce electricity economically, and he applied it to the production of light by the electric arc. He was, perhaps, the first to time that impetus which resulted in a few years in a considerable expansion of dynamo electric machinery as applied to lighting. These experiments of Gramme were carried on for a few years. His machine, I think, was built about 1869, and it was not until five or ten years had gone by that the machine began to be known in the scientific world. I saw a small Gramme machine about 1874 and it was a strikingly excellent example of a dynamo. All we had to do was to turn a little crank and a wire was heated to bright incandescence, apparently with very moderate effort, showing that the economy of the structure was high, that there was really very little waste—very little power being thrown away. One of my reminiscences is that I met M. Gramme in 1889 at the Paris Exposition and I found him to be a retiring, modest man who bore his honors very well, indeed, but who had the peculiarity of never appearing in public when he could help it. It is very difficult, they tell us, to get him out where he can be seen, and he only appeared on the occasion of the meeting of the Electrical Jury at the Exhibition. I think we should honor Gramme, not perhaps for the fact of his discovering a principle, but for the fact of producing for the first time a type of dynamo which was really well adapted to use in the industries. Before this time there had been discovered an important principle in dynamos; that is that a dynamo could start itself—magnetize itself and furnish its own magnetic field, as we term it—the reaction principle, it is called. Even this idea came only by degrees and was finally elaborated by a number of observers about the same time or very nearly the same time, but even at the time this reaction principle was well worked out, the machine was not such a structure as Gramme produced. Leading on from Gramme's time we find the Centennial exhibition, and there we find in the exhibition an exhibit of Gramme apparatus and this exhibit certainly showed some remarkable advances. There were arc lamps in operation, but there was also a little exhibit which was a very striking one—two Gramme machines, one driven by a belt and connected to the other, the other driven by the current developed by the first machine and working a little pump, producing, as it were, a miniature cataract of water—a very striking experiment indeed, and one which we now see applied on a large scale in the transmission of power. We had in that experiment the production of electricity from steam power, its conveyance by a wire only ten or fifteen feet across the space reserved for the Gramme exhibit, and we had the machine pumping water and producing a miniature waterfall. We sometimes reverse that process now. We have the waterfall and we turn the machine, then we carry the current a distance and we take the power, put it on a belt and use it to drive our machinery. These are precious reminiscences. They show us the beginning of the great industries which are now developing.

I took up the subject myself of investigating dynamo machines about the year 1874 and began the construction of small models. My attention had always been drawn strongly toward the electrical fields, and it might be of interest now to recount some of the difficulties experienced in the early days. I must not leave out here that the Gramme apparatus was not the only machinery devoted to electric lighting which was found at the Centennial exhibition. An enterprising American firm, Wallace & Sons, had constructed machinery known as the Wallace-Farmer machine, based on the ideas of Prof. Farmer, the venerable electrician, and they were applied to these machines in the Centennial to the lighting of the ground at night and the lighting of machinery hall in part, and the whole exhibit of the Wallace-Farmer machine and the apparatus showed that we had in our own country the nucleus of an expanding system, had it been pushed and caused to progress as the Gramme machine had. Even the machinery shown by the Wallace people was, some of it more advanced in type than the Gramme apparatus. From this time we find the arc growing by degrees. We find that in 1878 the Jablochkoff candle is lighting streets of Paris. The arc lamp for the Jablochkoff candle is only a form of the arc lamp. We find along the two sides of the Avenue de l'Opera a system which had, however, a comparatively short life on account of its expense. The lights were certainly very beautiful. The Paris Exposition of 1878 showed this apparatus in use, and alongside the Jablochkoff exhibit I remember distinctly seeing the ice machine of Pictet turning out tons of ice daily by steam power in the same room with the Jablochkoff exhibits, and Pictet was at that time well known on account of the fact that he had liquidified those gases which formerly had been regarded as incapable of being liquidified. He was the man who put such pressure and cold to bear on oxygen, nitrogen and other gases which up to that time had been regarded as fixed gases that they were turned into liquids, and even hydrogen, the thinnest of them all, had yielded to his persuasion.

To recount my own experience in electric lighting, I built a small dynamo about 1876 which would run an arc light. It was my first attempt at a machine of that size. It was successful and it led to the construction of other dynamos. When we came, to the commercial end of the business which began some here in 1878 and 1879, we found it was not enough—not by any means enough—to build a machine to run a light. There were difficulties to be overcome, and not the least of those difficulties was the getting of steady power to run the machine. I could tell story after story of the discomfitures depending largely on the absence of steady power or the presence of unsteady power. I remember distinctly that our first machine that was intended to be a commercial machine, and in fact the first machine which embodies the principles used in the Thomson-Houston arc apparatus—the three-coil armature—was a machine capable of running four to eight lights in series In fact the three-coil construction had never been used before, and this was a large machine. I remember distinctly that when the machine was put up for the first time—I had wound every inch of the wire myself and insulated the whole thing. The machine was elevated on a planer bed in the little shop in Philadelphia where it was made and the belt from the engine, which was called a 10-horse power engine, but which I think was not more than five, was put on the machine, and it was found necessary to tighten up the belt back to the engine. The machine could only be driven at a very moderate speed, and it astonished the machinists around to see how a thing, which apparently did not touch anything in revolving, could use up so much power. Those who had anything to do with the construction were all confident that the machine would not require power; they were sure that the engine would run a dozen such machines There was nothing to do but turn that machine around in air! Another incident in this connection I may mention it is rather an amusing one. We had got into making two or three machines in a small shop in Philadelphia, and a man came from the other side of the street where he had a small establishment and he said he had just the motor for the machine. He put his foot on the pulley of the dynamo on the floor and pushed it around, saying as he did so: "I have just got the thing that will drive that machine." I asked him what it was. He replied: "I make a little motor that runs sewing machines very nicely; why do you put such a big pulley on that machine?" I told him that if he would come in sometime when we were running the machine we would show him why the big pulley was on. He did come in later when the machine was under power. The power was very bad. It was so poor I found that the crown sheet of the boiler had been burned out after testing the machine and the whole contents of the boiler had escaped into the fire box. Fortunately there was no explosion and nobody was hurt. He came in and saw this machine operating with a big pulley; the belt on the one side being tight and the other side comparatively loose, and they showed him that by pushing the machine up and tightening it, it did not make much difference. There was still the pull there and he was very much puzzled indeed. He looked the machine all over and all around to see if there was anything rubbing between the armature and the field, and he went away and said he could not understand it. He came to me a few days later and said he had got it now; he understood it all perfectly. I said, "What have you made out of it?" "Oh," he said, "I see it; that machine makes electricity in a globular form, like globular lightning, and when it gets hold of that machine it just holds it there."

In starting our arc light experience, our first machine, the one I spoke of as being mounted on a planer bed and finding such difficulty to drive it, was put up in a bakery in Philadelphia where it was used all night and it was rather tenderly nursed by us. We had to be up there nights giving it as close attention as many babies require. Sometimes we were up all night attending to this baby and under conditions which were not altogether agreeable in midsummer either, because, as you know, bakeries require pretty large ovens and there is a good deal of waste heat about. The temperature by the thermometer in the room was frequently 140 and to live in that all night was somewhat difficult, as you may know. Prof. Houston and Mr. McCollin were working with me. We were working the machine for some few days in this high temperature in mid-summer when my associates were taken sick. They had all the symptoms of sunstroke. I kept my temperature within limits, but I had to suffer for it in other ways, the perspiration dripping through every pore and the ice water which I drank freely no sooner entered my system than it was out again through every pore in my body. I stood the racket, however, and came out unscathed. We then found that parties were interested in the development of electric lighting and at last a company was organized which is now the Thomson-Houston Electric company. It was organized in a modest way in the little town of New Britain, Conn., where I removed. I had previously been teaching in Philadelphia in the High Schools and I became electrician of this small company. Before it was organized an exhibit of apparatus was made at New Britain in a basket shop, as they call it—an old wooden building used at one time to make baskets, and there happened to be old machinery, basket moulds and forms and all kinds of machinery in the shop for the former use of basket making. It was turned into an electrical exhibition; that is what it amounted to. The lamps were scattered around the building. There was an adjoining building with a motor which was driven by current supplied from the main building; there was an engine which had the hardest work to furnish power, and the man in charge told me one day that when the steam was getting down he had taken a lot of those basket machines and burned them. I have no doubt that many of you in your early experience of electric lighting recall incidents somewhat akin to feeding hogs into the furnaces on the Mississippi steamers in order to keep up steam. There was need at that time of something more inflammable than coal, especially when the steam pressure gauge was going down at a lively rate. There was no let up in the dynamo. The dynamo must exert its back pressure. It has a certain current and a certain torque, and if we are using steam at sixty pounds we may be able to keep the thing going, but if we are using steam at forty pounds we are on the ragged edge of despair very soon, and we are forced to take heroic measures, even if it does mean the sacrifice of a lot of basket machines.

These were the beginnings of our experience. We soon got into another shop at New Britain and began the making of apparatus for commercial use. Even here we had difficulty with power—steady power was what we wanted in order to be enabled to tell what we were doing, and I have no doubt that all those who had experience in the early days with electric lighting felt the necessities that we felt. But if anything has done more than another to develop the steam engine it has been electric lighting. I think the steam engineering business owes as much of its present development to electric lighting as to anything else—in fact owes all of it, nearly. The engines which were good enough to drive mill machinery and to drive ordinary machinery whether the speed ran up or down were not good enough to keep a steady glow in the lamp. They were not good enough to keep up just the same pressure and just the same volume of current under the conditions of practice, and the engine builders soon discovered that that was the case, and I may say that we have here in Providence the representatives of some of the most progressive engineers who were the first to recognize the fact that the old style engines were not altogether the best suited for electric works—the Armington & Sims people.

After we got into operation our difficulties were not by any means over. We had to develop all sorts of devices, we had to overcome difficulties which were constantly arising to discourage us and dishearten us, but by keeping at it we finally succeeded in getting our apparatus where it could be taken care of by an ordinary man; where, in other words, we could put it into a factory or in a station and not require a highly skilled electrician to look after it. When this was accomplished we were met by other reverses. The Brush company saw our beginnings of success. They were then the chief parties in the field of arc lighting. They bought up the majority interests in our little company in New Britain, apparently for the purpose of swallowing us and laying us on the shelf, to use a common expression. Subsequently, however, in the same year certain parties in Lynn purchased the majority interest in the stock of what was then the American Electric company of New Britain, and started operations in Lynn. The Brush company, I may say, as you are probably all aware, now has been swallowed up by this infant that they had tried to swallow. Such is fate.

I need not prolong this statement much further. I have merely to say what you all know that we have the supremest confidence in the expansion of the electric industries. We are absolutely certain that our business is going to be greater and greater as time goes on. We are sure that we are living in an electric age and I may say that we look to you gentlemen of the National Electric Light association and we are ready to state our obligations to you fully for that which has made it possible for us to carry on our works for commercial expansion. We look to you to see that the country is covered with plants. You have done noble work in the past. You have done more than the people fully realize. At times when discouragements came, when things were not altogether as bright as they might be, in fact when the lights were not as bright as they might be, or as steady as they might be you stood in the breach with us and overcame the difficulty. With you it was the difficulties of commercial exploitation, the systematizing of those things which concern station operations and commercial developments. For ourselves we have had to overcome difficulties and to provide for this and that in the way of invention and development. The work will go on progressively. We have calls now for dynamos up to 500 to 1000 horse power where a few years ago we thought it would be an unusual thing—it was indeed an unusual thing to have 100 or 150 or 200 horse power machines spoken of, and it looks very much as though in the near future machines of a much larger capacity would be demanded for electric installations.

I am down on the programme to-day to say something about electric welding. I was going to say here that I did not know exactly when that art was discovered and that I believe that the formation of the National Electric Light association was one of the steps in the process, figuratively speaking. It is gratifying indeed to see the electric welding operation going on here. These meetings undoubtedly bring together and harmonize the various members of the electric light fraternity—the men who produce the machines and apparatus, and carry on the manufacture, and the men who use them in commerce. Our interests are undoubtedly common. Our interests are to produce the best that can be had and to use it in the best way possible.

Coming now to the actual, not the figurative electric welding, I may say that my time has been largely given lately to electric light matters rather than welding. It was my fortune to come upon the fact and develop the fact that metals can be worked, and especially welded by electrical heating and to apply it in practice. The art is a growing one and quite a number of machines are now in active operation doing this kind of work. I may touch here upon a matter of interest which is akin to electric welding, and that is the general subject of electric heating. We sometimes are asked the question as to whether it will ever be possible to heat our houses by electricity, whether heating this, that and the other thing can be done. I should answer that question as I have done frequently. It is not at all likely that we will ever heat extensively by electricity unless we can find some way of converting the energy of coal into electricity far more directly and less wastefully than is done in steam engines of the present day. When we consider that under the very best conditions and with the very best engines we can realize only a small percentage in electricity—10 per cent. perhaps of the heating energy of the coal—and that when we turn that 10 per cent. of electricity into heat we get a little less than 10 per cent., it is evident that we cannot afford it. I noticed that a part of the discussion yesterday, as reported, was in reference to the utilization of the waste steam from the electric light plant for heating purposes, and indeed that seems to be a direction in which much valuable work can be done. There you have got through, as it were, with the steam; you have obtained all the power you can get out of it, or nearly all, and you have got an immense amount of heat left which is good enough for general heating purposes. There is a case, of course, where we can combine the two, not developing the heat by electricity but rather taking the heat that is left over after we have got our electricity and using it for heating, but of course exhaust steam does not apply to special cases where the heat is required to be very high. In that case we may find a moderate expansion of electrical application, as in cooking on a limited scale. It is so simple a matter to turn on a current and turn it off getting a moderately high temperature out of the resistance through which the current passes, that there is not any question in my mind but what there is to be a considerable expansion of heating apparatus worked electrically where the conditions of economy are not so pressing as in the case that I have mentioned in general heating.

I might close my remarks by simply stating that in regard to the electric railway I hope indeed to live to see the time when some of our larger roads will be in operation as they should be and can be by electricity. I hope also that the time may come when we shall have at our command an easy, direct method of obtaining electricity from fuel. That is the great cry nowadays. Can we obtain electricity directly from the coal without going through the steam engine and boiler which must involve a large loss? It almost seems from all that we who are actively engaged in looking up matters in this connection can say, that we must wait for some new discovery—for another Faraday to come forward and show us principles which are not now known—some relation between electric energy and heat energy whereby we can convert even 35 or 40 per cent.—we will be satisfied with that—of heat energy into electric energy. We hope it may be so. The steam engine would disappear. The steam locomotive would disappear. The steamship would be propelled no longer by the steam boiler and the burning of fuel under a steam boiler. That fuel would be burned, undoubtedly. We should have to rely on the use of fuel in one way or another, but it would be burnt to produce currents The apparatus which would propel the steamship would not be a steam engine with its reciprocating motions and its racking strain, but it would be that quiet rotary motion which characterizes the modern electric motor. It is not at all impossible to construct machines of that kind which would work up to many thousands of horse power, and thereby parallel the modern steam engine which is used on all steamship lines.

THE PRESIDENT: One of the most important branches of our industry, one that has enlisted energy and capital to a very great extent in the last three or four years, is that of propelling our street cars by electricity. We have with us this morning, and I take great pleasure in presenting him, F. H. Monks of the West End Electric railway of Boston, which is actually operating more miles than any other system in the country.

THE ELECTRIC STREET RAILWAY.

MR. MONKS: As late as yesterday afternoon I was requested by Mr. Whitney, the president of the West End Street railway of Boston, to appear here to-day to represent the company before this convention. The business of electric street railroading has no glorious history like that of the telephone, the telegraph or the electric light. We have but a meager record up to date. We are yet in our infancy and we expect to live more in what we might call a glorious future. The records show that in 1835 Davenport of Vermont exhibited in Boston an electrical locomotive. That I believe is the first record of any electrically propelled machine of any kind. In 1848 Farmer showed a locomotive with a car attached which was capable of carrying one or two persons. In 1852 Congress appropriated $30,000 and the money was expended by Prof. Charles G Page, who experimented with an electric locomotive, using batteries of the Grove type. The experiment was only partially successful and work was soon discontinued. In 1850 Thomas Hall of Boston made an electrical locomotive which was exhibited at the Mechanics' Charitable Association Fair in Quincy Hall. It was at that time the marvel of the day. But few understood it, and it was looked upon with wonder. In 1860 Hall exhibited an improvement upon his previous locomotive. It ran upon a circular track and gave real evidence of a practical everyday machine. It was named the Volta and I think is yet in existence. As we all know Siemens used a third rail for moving an electric locomotive in Berlin in 1875. At Scranton, Pa., we find that there were three cars run in the spring of 1887 with motors on the front platform. The first road perhaps to be operated on any extensive scale was at Richmond, Va., which started operation under the Sprague system in the spring of 1888. Before the close of the year some forty cars were in operation. That practically brings us up to to-day. That is practically the history—all the history of electric street railroads. Therefore, as I say, we are living to-day more in expectation of what the future may have in store for us than in any glorious past.

I have been told by your secretary that this is a meeting at which reminiscences may be indulged in, and therefore I speak of the time when I first went to Richmond in the spring of 1888. It was in May of that year that I first went there and there I received my baptism, as it were, in regard to electricity. I am in no wise an expert nor am I scientific in electrical matters. I simply have to do with practical operations of roads. But I was very greatly impressed when I went to Richmond and I became thoroughly convinced when I saw what was being done by Mr. Sprague and his fellow officers in the company there that we were just entering upon the threshold of a new era in regard to the matter of street railroading, which promised magnificent results. I went afterward to Jamaica, in Long Island, and I saw there what is known as a double overhead trolley wire system. It was a very curious sight to me then and would be undoubtedly now. The roadbed was very poor. The cars were worn and dilapidated, and the whole thing might be looked upon in the light of a byword in street railroads. I noticed that the roadbed was in such shockingly bad shape that it was difficult for anybody to keep his seat and I noticed that on the back platform were carried sundry and divers pieces of rail, and upon asking their use I found that the conductor used them to replace the car on the track when it jumped off, as it frequently did. I noticed again, too, that very nearly, if not quite all the windows in the car were broken, and upon inquiry I found that the overhead line was in such bad order that the trolleys were constantly falling off and coming down on the sides of the car and breaking all the windows in that way. I went up to the middle of the line where the superintendent's office was. I saw in one side of the window a salt box with a drum head cover to it. It was a curious looking thing and I asked the superintendent what it was there for. "Oh," he said, "that is my telephone. I have that attached to the wire outside and I can hear, as I sit at my desk writing, the car coming along the line, and if it goes off the track I know it and then I go down there and help them put it on." As a matter of fact, in a few moments after that I commenced to hear a confused sound in the telephone, very much the same as if a small boy was in the next room hammering tacks into the floor, and it continued for some time. I said, "I suppose that is the car coming?" The superintendent said "Yes, that is the car." It grew louder and louder. I finally said, "She seems to be making noise enough." "Yes," said he, "but she is all right; I can tell when she is off the track. You need not fear." I also saw a primitive road at one time in Binghamton, in New York state, where they had a single overhead trolley system. Of course, those things are now matters of history, and we come to what is the electric railroad of to-day. Perhaps before that, I might speak of the matter of the introduction of electricity for street railways in Boston. On the first day of January, 1889, after several months of preparation, the first electric car was started under the Sprague system, and later the Thomson-Houston system was put in operation in Cambridge. Since that time there has been no backward step and there have been continued and renewed expressions of opinion both by the officials of the company and by the public generally of confidence in the system of the propulsion of street cars by electricity. Experiments have been made in regard to the matter of storage batteries. Perhaps there is no ignis fatuus on the face of the earth which is so seductive to the street railway man as the idea of a storage battery. But it is an ignis fatuus up to date. We have never been able to see anything in it.

We have had our difficulties in Boston, of course, but we have also a glorious history to record in regard to what we have done. Last summer, during the visit of the Grand Army to Boston, we carried on our entire system 3,000,000 passengers in one week, and out of the 3,000,000 we carried more than 1,000,000 on our electric cars in one week, and that without the slightest hitch of any kind, without any trip being missed, and without any person being injured in any degree. At present we have sixty miles of electric track, with something over 300 cars. We are running about 18,000 miles a day electrically, or about three-quarters the distance around the globe, and we are carrying from 100 000 to 125,000 passengers by electricity. The experiment in Boston, if such it may be called at this late date, has passed to a stage where the public not only consents to its extension, but actually demands it. From all quarters—and we cover a very large area, having some 260 miles of track in the towns and cities surrounding Boston—we have constant and repeated demands for the immediate introduction of the electrical system, so that where it has been a matter of grave and great difficulty heretofore to pacify the public mind respecting the matter of introduction of electric roads, with us in Boston it becomes now simply a question of not getting the system in fast enough.

But, after all is said and done, we are but in our experimental stage; we are in our infancy. Much remains to be done by the electric companies in regard to the improvement in motors, in the way of cheapening their product so as to give it to the railway companies at a decidedly cheaper price than it can be sold at to-day. Much remains to be done to perfect the system in regard to the proper form of car to be used, the proper form of rail and a thousand and one details, in order to make an electrical system in a metropolitan city a great success. They say there is nothing new under the sun, and therefore, sometimes we are forced to go back to first principles in order to determine the best way to conduct our business to-day. Having given the subject much careful consideration I am very strongly of the opinion—and my opinion is strengthened with the lapse of time—that the future electric street railroad will not use its motors under the car. I do not believe it is possible for a motor to be built to be used under the car which will give that degree of life and durability which the rough, hard usage of a street railroad is bound to impose. I think, on the other hand, that the electrical locomotive or motor car is going to be the Moses which will lead us into the promised land. For many reasons the electric locomotive is decidly preferable to the use of motors under a car. The first one, and perhaps the most important, is the fact that in Boston, in Providence, in Worcester, in fact all the large New England cities, a double equipment of cars is necessary. We need motor cars for winter use. We need motor cars for summer use. What we want to find in the practical ends of the business is a medium or force or power which will enable us to draw our box car on the morning of the fourth day of July, when it is cold and rainy and to use the same force or power to draw our open car in the afternoon of the same day when it comes out fine and beautiful and the thermometer registers 70 degrees. The present type of motor car which is now so widely known does not give us those opportunities and I doubt very much whether any street railroad can afford to go into the problem of buying motors with all the electrical machinery incident thereto for two equipments, one for the box car and one for the open car.

R. W. Pope introduced the following resolutions which were unanimously adopted by a rising vote:

Resolved, That the National Electric Light association, assembled to celebrate the decennial anniversary of the establishment of the electric lighting industry in the United States, fully appreciating the value of the discoveries and inventions of Joseph Henry, heartily approves of the proposition now before congress to bestow substantial recompense upon the daughter of the great discoverer, who, during a lifetime devoted to science, received no financial compensation for the benefit he conferred upon mankind.

Resolved, That a copy of these resolutions be forwarded to both houses of congress.

E. R. WEEKS: While listening to the delightfully frank and pleasant expressions of experience this morning, it occurred to me that it might be of interest to the convention to know that in Kansas City, where is located the oldest Thomson-Houston central station, we are still operating some of the original ten-light machines built by the original American Electric company in the old factory in New Britain, of which Professor Thomson has told you. Using the metaphor of the gentleman from Boston, it might also be interesting to the convention to know that, equipped with that tackle—for which, by the way, we paid right handsomely—we did not come home and we do not stand before you to-day with an empty swing.

THE PRESIDENT: I presume that that was the machine that they burnt the basket apparatus up to test?

Mr. Monks of Boston, has stated that street railway systems have no past; they have grabbed the present and are going to secure the future. Unlike the street railway system the National Electric Light association has a past, one extremely interesting and widely varying in interest. We have been promised in that direction a paper from George Worthington. Unfortunately he is detained at home by illness and Charles W. Price has kindly consented to respond in his behalf.

ORGANIZATION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

CHAS. W. PRICE: Fortunately for me, though perhaps not for the association, I was present at the birth of the National Electric Light association, an organization which through many changes of everything else, has never changed its name, and is still known by the title given it in Chicago six years ago. I think every line of the first constitution and by-laws has been changed with this exception, for when other portions of the programme failed, a report from the committee on amendments would be de-

pended on, and this committee was appointed as regularly as the association assembled in convention. These amendments were not always improvements. Having had an humble part in the construction of the first constitution, you will understand of course I can speak from an unprejudiced standpoint.

The first convention was composed of many of the pioneers in electrical work, energetic and progressive men. Next to those engaged in the electric lighting, gentlemen representing the carbon industry were the most numerous —not even excepting at that time the newspaper men— and our friends who dealt in general electrical supplies gave friendly and able aid at all times. No one seemed to fully understand why the meeting had been called, one delegate stating at the first session that he came because his parent company advised him not to.

The first meeting of the National Electric Light association was held in the parlors of the Grand Pacific hotel, Chicago, at 11 o'clock A. M., February 25, 1885, six years ago. William A. Hovey, at that time one of the editors of the *Electrical Review* of New York, called the meeting to order, and stated that the call had been issued by his journal on the request of a large number engaged in the business of supplying electric light.

George S. Bowen, then with the VanDepoele Electric company of Chicago, was elected temporary chairman, and Henry Dwight Stanley, then and now and probably forever representing the Bridgeport Brass company, was elected temporary secretary. Mr. Bowen, on taking the chair, spoke briefly of the bright future he thought was in store for the electric light, remarked that the science was "still in its infancy," and expressed a confidence that valuable results would grow out of the convention. You all agree, undoubtedly, with Mr. Bowen's predictions.

A committee on credentials and permanent organization was appointed, consisting of the following named gentlemen: Charles A. Brown of Chicago, C. J. Richards, Racine, Wis., George Herbert Wadsworth, of Cleveland, (since deceased), Frank Ridlon of Boston, and S. Baldwin of Baltimore.

A committee on programme and progress of business—please note the title—consisting of about one-third of the delegates to the convention, was appointed, and then we adjourned for lunch.

On re-convening, Mayor Carter Harrison of Chicago welcomed the visitors. Speaking from memory, I remember that he said that "electricity was the most subtle of fluids, that it was the most powerful, the greatest agency handled by man." "It was," he said, "the breath of Deity. It could rend the giant oak, melt the granite of ages, yet in the incandescent light it was as soft as down on a woman's cheek."

Then we all stood up and cheered Carter Harrison.

Prof. Elisha Gray also spoke a few words of welcome, and gave electricity the credit of being the greatest wonder of the century, and varied the infancy remark by predicting that we were only on the threshold of its wonders. Then all applauded Prof. Gray, and everybody present felt proud of his calling.

The committee on permanent organization, which had been penned up in a room, and compelled to go hungry until the report was made, then filed into the room. The peaceful look on their countenances gave no indication of the strife and controversy that had occurred in that committee room, where they had been in attendance on the birth of this association. The committee was fortunately a comprehensive one, and from a host of candidates made admirable selections, as follows, and the report was unanimously adopted by the convention: President, J. F. Morrison, Baltimore; vice-presidents, M. M. Cleveland, Hartford, Conn.; J. H. Yarbrough, Nashville, Tenn., E. R. Weeks, Kansas City, Mo; secretary and treasurer, William A. Hovey of New York; executive committee, George S. Bowen of Chicago, Wm. Hochhausen of New York; Gilbert Donaldson of St. Paul, Frank Ridlon of Boston; John R. Fletcher of Akron, Ohio, and Geo. O'Connor of New Orleans.

I remember that the convention was astonished by the figures given by George Fletcher of Dixon, Ill., of the cost to him per light. Some one asked how much he paid his engineer? Who was his engineer? "The good Lord is my engineer," said Mr. Fletcher. This he explained by stating that he employed water-power by means of which a turbine water wheel ran a saw mill and other mills and incidentally his electric light plant.

Mr. VanDepoele stated that electricity could be used for transmitting power No one will dispute that fact to-day, or that Mr. VanDepoele was one of the first to prove it.

Proposition nine, relating to the use of the Nos 6 and 4 wire in the same line, was decided in the affirmative. Whether frost could damage armatures in transportation was answered in the negative by Mr. VanDepoele.

This convention adjourned after a two days' session and its subsequent history you are all well acquainted with.

In conclusion it is scarcely necessary for me to speak of the great usefulness and wide influence of this association. Starting with a membership of less than fifty, it now has I believe, several hundred, and it has been the means of promoting a fraternal feeling throughout the entire electrical industry, of at once bringing to the front the most meritorious work of the alert inventors, and to an extent, not easily calculable, made every electric light man acquainted with the most successful and modern manner of conducting his business. Neither can it be said to have fulfilled its mission. There is much and still greater work to do, as this great science continues to expand. No organization, and I speak advisedly, has done as much to promote the best interests of the whole field of this industry as your association.

That the good work begun in doubt and with many misgivings in the city of Chicago six years ago, may continue to still greater usefulness and honor, is the sincere wish of your present speaker.

THE PRESIDENT: As representing the particular department of incandescent lighting, J. H. Herrick, first vice president of the Edison Electric company of New York City, will now address you.

INCANDESCENT LIGHTING.

MR. HERRICK: I do not believe it is in the books, but it seems to me in preparing for this occasion so far as I might that the original incandescent lamp has been omitted from the books, and I claim that a man named Moses discovered the first incandescent lamp, because it was incandescent, it was a vegetable filament and it did not consume. Now from that time to Thales—I think it was, Mr. Lockwood—and from that time on, somewhere in the neighborhood of 1820, the world was wishing for the return of that same incandescent light, but it did not come. As I understand from some of the scientific speakers ahead of me, Mr. Faraday discovered in the neighborhood of 1825 some method of running a powerful current over a large conductor through a low resistance incandescent carbon and made, as my celebrated friend, the professor, has suggested, a brilliant, beautiful laboratory experiment, and the light went along in just about that shape until somewhere in the neighborhood of 1875, when Mr. Edison having completed the quadruplex telegraphic invention, was enabled to turn his attention to the incandescent light. Now as to the benefits of this incandescent lamp, we have been in this room a couple of hours and we have used up a great deal of the oxygen. Every five foot gas burner consumes nine cubic feet of oxygen and the room begins to feel oppressive. One of the principal advantages of this light is that we do not use any oxygen and we only produce one-fifteenth part of the heat and we take the light into the domestic circle and make life pleasant and happy, because the air is good. Now I am very fond of parallels and it seems to me that the incandescent lamp is very much parallel in many respects to human life. The great men of the past and present have elevated manhood and benefited the common community by the measure of resistance they have been able to offer to the obstacles, the trials, the disappointments of daily life, and just so in our incandescent lamp, by the measure of its resistance you measure the brilliancy of its effect. Again, human genius, human talent may be overwrought, overworked and cease to benefit us all. So it is with the incandescent light, if overwrought by the current, is destroyed. There is no man fit to belong to the electrical fraternity who does not believe in the scientist's dreams. What we have achieved in the past was largely owing to the dream put into reality, of our scientists. What we may expect in the future will depend upon by how much faith, by how much energy, by how much genius, we endeavor to realize the dream of these scientists.

THE PRESIDENT: It was related that in the early days of electric lighting in the city of Boston when the old Brush company was just afraid of its coal being exhausted and there were two firemen in the room, that Frank Ridlon ordered one fireman to be thrown into the furnace to keep the steam up until the load of coal arrived. One of the survivors of the old basket factory in New Britain who has come down to us from those early days of electric lighting in comparatively a good state of preservation, is E. Wilbur Rice of the Thomson-Houston company of Lynn. We shall be glad to hear from him.

MR. RICE: I was very much interested to hear Prof. Thomson speak of what he saw in London and it occurred to me that I had a similar experience one time with Prof. Thomson himself when I visited the Central High School, one afternoon after school, to examine some of Prof. Thomson's old works. I saw there a dynamo which the professor assured me was the first one that he had ever built. This dynamo, curious to relate, was so wound and connected by Prof. Thomson on different occasions that it involved many of the principles which have since become well known, but at that time were unknown. He had the winding so arranged that it could be used in shunt, in series and in series shunt which is practically known to-day as the compound winding and which is used so much in connection with incandescent lighting. Prof. Thomson did not publish it at that time and told me that he did not think he was doing anything particular. I may say in this connection that Prof. Thomson did a great many things of this kind that were equally great but which seemed to him so ordinary and such a matter of course that he neglected to say or do anything about it. I was a student at the High School of Philadelphia at the time when Prof. Thomson visited Europe in 1878. Upon his return I was greatly delighted to hear his enthusiastic account of what he had seen and I know I was very much interested to learn that he intended to go into such a line of work. I remember one of the first large machines driven by power which was built by Prof. Thomson, was used in a lecture at the Franklin Institute, given in the winter of 1878-'79 shortly after the professor's return from Europe. This dynamo was driven by a steam engine belonging to the Franklin Institute and was used to run a very brilliant light. In those days an arc light was quite a novelty, and I well remember the impression it made upon me although I was quite a young man—a mere boy at the time of the centennial exhibition

The early days of the promotion of the Thomson-Houston company in Lynn, or the old American company, are of course quite familiar to me as I was one of the first employes along with Prof. Thomson. In those days we were not quite so busy as we are at present, and although the factory was quite small the room was quite large for the amount of work we accomplished. I know that on the upper floors of the factory it was quite a customary thing for some of the boys to build double rippers and to exercise on bicycles. One of the first pieces of work upon which I was set on arriving at New Britain was whitewashing Prof. Thomson's office and brightening up the machinery, and numerous other like employments. Prof. Thomson was engaged on work somewhat similar on some occasions. I remember when he assisted in putting a partition around his office in order to get a place where he could do some quiet work. The company was too poor or was unwilling to buy electrical instruments, and Prof. Thomson had to make a great many with his own hands. Perhaps to give one an idea of the great advancement during the past ten years I may state that a great many of the familiar words, such as volt and ampere, were at that time entirely unknown. We measured our currents in webers, and I think that the word ampere was not generally adopted until 1881 or 1882. The first machine which we built in the old factory was a one-light machine which weighed something like one hundred and fifty to two hundred pounds. I remember well that we used to exercise our strength in attempting to lift it, and a great many succeeded. To-day we are building machines weighing 65,000 pounds. The output of those little machines was one arc light, measured in our electrical nomenclature 500 watt. To-day the machines that I am speaking of will give an output of over 500,000 watts. This little machine of which I speak required about one and a half to two horse power to drive it, and the large machines we are building to-day require about 700 horse power. I think after the close of the year 1881 we had in use something like one hundred arc lights all told. To day I believe there are something like one hundred thousand arc lights in operation. This gives you some idea of the growth of one company and of one branch of its work, and there is no question that the general electrical industry has developed in like manner.

GEORGE M. PHELPS presented this resolution, which was unanimously adopted:

WHEREAS, The members of the National Electric Light association assembled in its thirteenth convention have learned of the serious illness of George Worthington, whose genial presence is missed by all and whose conspicuous services to electrical industries in promoting the organization of the association is recalled by all, it is

Resolved, That the association hereby expresses its cordial esteem for Mr. Worthington, its appreciation of his many services and its heartfelt wishes for his early recovery of health and strength, and that the secretary is requested to forward a copy of the resolution to Mr. Worthington.

THE PRESIDENT: First almost in the field of transmission and utilization of electrical energy for power purposes, and I believe the first to make a practical application and demonstration for the propelling of our street cars is a gentleman whom we have with us to-day, so well known to you that I shall simply introduce him by calling his name—Frank Sprague.

ADDRESS BY FRANK SPRAGUE.

MR. SPRAGUE: While the hum of the motor may be called the song of emancipation, like the hum of many another song it is best when quietest. Since my early musical education was neglected I am not able to compose music to go with it. I once made the remark that I owed much to Providence, energy and the industries of Providence for some of the earliest success in electric railway work. A gentleman looked at me and said in a somewhat sarcastic manner, "I think you do owe much to Providence."

I remember in 1879 I was on duty on board of a naval vessel of the United States on the coast of Japan. I had before that time been at the Naval Academy, graduating there in 1878, and just at the time that Edison, Bell and other electricians were prominent in the field, and there grew up in my mind a love for electrical matters and the desire to be associated in some way with electrical developments. The United States navy at that time was not very encouraging to any such ambition. I went the way of all other midshipmen and drifted out to Asia, but the stories came of the discoveries being made in electric lighting by Thomson, Brush and Bell, and I became very nervous. I was trying to invent an electric motor and I meditated very seriously sending a request to the Navy Department to be allowed to come home in a sailing vessel, as I could not well afford to come home in any other way. Well, by some good intervention I was ordered back to the United States, and I went to Ansonia, Conn., and saw an experiment in the transmission of power which greatly impressed me. Mr. Wallace, of Wallace & Sons, of Ansonia, is a man whose position in the history of this enterprise has never been fully appreciated. I went there knowing him personally and was taken through his factory, and he said, "Sprague, let me show you something." He had one of those old four-pole armature machines. He had it connected with a dynamo. He turned on the current and pretty soon this thing was running two or three thousand revolutions a minute. He said, "It is no good." I asked him, "Why?" He said, "I will show you," and turning to one of the men—a large, strong man, he said, "Get hold of the armature." This armature, I suppose, was about ten inches in diameter. He got hold with the brake on the arm of it and finally began to bring it down, lowering its speed, and finally brought it to a dead rest. In that simple experiment he outlined and he overlooked the most important fact that he had to deal with—that the energy which was being developed was not the sole question to be considered, but there was also to be considered its torsional effort multiplied by the speed with which it was traveling. Had Mr. Wallace seized on that single point, or had I or had anybody else seized upon it at that time the transmission of power would then have been very much advanced. Mr. Wallace at that time, if I remember rightly, was building a machine invented by Mr. Farmer—certainly one of the earliest and most esteemed pioneers of electric science in this country. Mr. Farmer was then a crippled man confined to his chair. He was attached to the torpedo station at Newport, and he had invented a machine for use in torpedo work on board ship. One of his machines was one of the first machines that I ever had the pleasure of dealing with. With a lack perhaps of some little formality which is necessary in official life, I applied for the whole second floor of a machine shop in the Brooklyn Navy yard. I think that was in 1880 or 1881. I got one lathe and in that lathe I set up a Wallace Farmer machine and tried my first experiment in the building of a dynamo or motor. My work from that time fell off. My duties called me out of the United States, and it was not until 1882 at the electrical exposition in London that I was brought to a consideration of the tremendous advance that electricity was making. Few of you are familiar, perhaps, with the inside difficulties with

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J. W. DICKERSON, - - - - - - - - } Associate Editors.
J. B. O'HARA, - - - - - - - - - - }
F. L. PERRY, - - - - - - - - - - }
A. C. DURBOROW, JR., - - - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE next convention of the National Electric Light association will be held at Montreal in August next.

MOST American electricians are more or less interested in Ferranti's work in London and for this reason Caryl D. Haskins' paper on "The Ferranti System," which was read at the last meeting of the National Electric Light association and is presented in this issue, will prove of interest. Mr. Haskins has served under Mr. Ferranti and his account of the machinery, conductors, etc., employed, is doubtless, one of the most reliable. As Mr. Ferranti and his system at one time were rather roughly handled by an electrical journal on account of the failure of certain cables in the system, Mr. Haskins' explanation of the difficulty leads one to believe that injustice has been done.

PERHAPS one of the most interesting features of the convention of the National Electric Light association was the celebration of the first decennial of the use of electricity for light and power. The addresses which were made by representatives of the several branches of electrical industry were highly entertaining and instructive. Prof. Thomson spoke of the development of arc lighting and welding; Frank Sprague dwelt upon the installation of the noted Richmond electric railway; Thomas D. Lockwood spoke for the telegraph and telephone; Mr. Herrick responded for the Edison incandescent system; E. Wilbur Rice related a great many interesting incidents connected with the early days of electric lighting. It was a symposium which will always be memorable in the history of the association.

F. H. PRENTISS, in his paper read at the convention of the Electric Light association and presented in full in this issue, considered the subject of the distribution of steam from central stations. The stand was taken that it is commercially feasible and practical to combine a system of steam distribution from a central station with an electric light plant, in such a manner as to utilize the exhaust. There is no doubt that the average electric lighting plant as now run is a wasteful combination of lighting machinery. When we compare it with the modern gas house we find that where the apparatus in one plant must needs be kept idle during a great portion of the time, that of the other plant can be utilized to store up a product and by-products to be delivered later on. Mr. Prentiss claims that the chief trouble encountered in distributing steam has been the difficulty of securing absolutely tight joints, but he asserts that this obstacle has been overcome. If, then, steam distribution is thoroughly practical many of our largest electric lighting plants are not availing themselves of a splendid opportunity to increase dividends. Perhaps Mr. Prentiss' effort may be the means of awakening managers to the fact that the by-product, exhaust steam, which is now wasted, might be sold at a profit.

"IT is curious that notwithstanding the fact that as a source of illumination the electric arc has been known since the beginning of the century, the scientific study of its nature has been but little pursued." These words, at the beginning of Prof. Elihu Thomson's paper on the "Electric Arc and its Use in Lighting," which was read at the convention of the National Electric Light association, are a good preface for what followed. Starting in with a little of ancient history, Prof. Thomson leads the reader along through an account of a number of interesting facts and experiments relative not only to the arc itself but also to the mechanism of the lamp. The arc he defines as being "composed of a stream of vapor arising from the actual boiling or vaporization of the solid or fused ends of the separated conductors." Referring to the fact that he had been able to bend small carbon pencils by passing a sufficient current through them, and that under such circumstances they emitted light of an intensity approaching that of the arc, Prof. Thomson pointed out that these facts indicated the possibility of the "fusion of carbon into liquid carbon at arc temperature under a high pressure of inert gas." Another curious fact relating to the distribution of potential in the arc was mentioned. Prof. Thomson spoke of Dr. J. A. Fleming having shown that the difference of potential between the positive carbon and the arc flame is about forty volts and that the entire forty-five volts is made up by the addition of the few volts' difference of potential between the flame and the negative pencil. Speaking of an arc operated upon by alternating currents, we are reminded that unless the alternations are rapid the arc is liable to extinction at the zero points of current, especially when run in a draft of air. Touching upon the obstacles to the employment of small arcs with, say, three or four amperes of current, Prof. Thomson stated that the chief one was the difficulty of obtaining suitably uniform carbons. Prof. Thomson's lecture was replete with matter which after a careful reading will prove of the greatest value to those making a study of the arc lamp.

IN a paper read before the National Electric Light association, Frederick C. A. Perrine addressed the members as business men. He advocated the organization by electrical companies of a mutual society of confidence. He took as his text the recent financial crisis, and said that the lessons which had been learned by bankers should be studied by electrical companies. Mr. Perrine suggested the idea of forming a society which should have as its object the insurance of accounts. Losses, including such as are incident to general business, bad management, dishonesty, and failures he estimated at one-half of one per cent. of the accounts. If a mutual company were formed to insure the accounts or to divide the losses among the many, no single concern would be burdened. The plan as sketched out by Mr. Perrine would be "to form among electrical companies a mutual society, each company pledging individually its entire capital for the assurance of all accounts outstanding against any members." That the association appear as an indorser on notes or as an insurer of accounts when called upon by any member, would be the simplest plan of operation according to Mr. Perrine. While the suggestion of the insurance of an account may seem to be a rather startling innovation, the scheme, the author of the paper thinks, is based upon a more substantial foundation than insurance against loss by fire or accident. The effect of the establishment of a system of mutual insurance of accounts, Mr. Perrine asserts, would be that of increased capital in the business; creditors would be relieved of much of their anxiety; and the stocks and bonds of the associated concerns would be rendered more stable.

The Providence convention of the National Electric Light association was one of the most interesting in the history of the association. There were 65 representatives of central stations in attendance according to the secretary's record. This is a noteworthy fact, and one on which the association may well be congratulated. The delegates moreover attended the meetings in larger numbers than on former occasions and they evinced a greater interest in the proceedings. Everything tended to increase the interest of the members and the outlook for the association is much brighter than at any time in the history of the organization. There were many papers and reports of committees presented which were especially valuable to central station managers. The report of the committee on the rating of incandescent lamps was in the same line as that presented at a former meeting. It will prove highly interesting to managers of incandescent stations. T. Carpenter Smith's paper was another valuable contribution and was pronounced the most practical address of the convention. So deeply were the members impressed by this fact that it was decided to make a special order of its discussion at the next meeting. This was due to the fact that the paper was not presented until near the close of the meeting, and it was desired not to dispose of the subject until it had been thoroughly discussed. There was another discussion of the question of unfavorable legislation, and at this time when legislatures appear to desire to cripple the electrical industries of the country, the interest of the association will prove valuable. Several states were heard from, Massachusetts, and Illinois particularly, where the electric light, power and the telephone interests are threatened. In these states an active defense is being conducted through the agency of state associations formed by the National body. The earnest work of the association in this line would of itself earn the lasting gratitude of every company in the country. Coming at this time it may be expected to awaken additional interest among central station managers in the work of the association.

[*Continued from page* 111.]

which we had to deal in the history of the electric railway enterprise and the amount which it was necessary to conceal from the general public. The contract for the road in Richmond was taken in 1887. I had never seen the road. I remember to this day the impression that came over me. I had been talking with John Stephenson, the pioneer car builder of the United States, and he said, "I do not believe that any self-propelling car can operate under street car conditions. I am acquainted with fourteen of them in the city of Paris." I said, "Mr. Stephenson, there has been one difficulty with those—not one of them utilizes the weight of the car for the purpose of traction. The first machines that were built were built for storage battery experiments on the West End in Boston. Subsequently when I went to Richmond I saw a grade of ten per cent. My heart fell within me and I said it is utterly impossible for any car to climb that hill. I came back to New York and had some consultation in a retired room. Is it possible for any car to mount a ten per cent. grade? Everybody said it is not, and I confess that I myself thought it was not. Shall we use a cable on that ten per cent. grade and trust to electricity for the balance, or shall we change the gearing of the machine? We had a single geared machine. Mr. Johnson, who I think is a sort of John the Baptist in the electrical profession—a sort of forerunner of good things—said we better find if we can get up the grade at all Back to Richmond I posted. I started out one night when there had been an election and when the streets were filled with a crowd of drunken men. We went down in great shape and then just before us was this grade. I said to the superintendent, "We cannot mount it." "Well," he said, "it will go up and I will bet you five dollars I will take you up." We started and we mounted the hill. When we got to the top it had settled the question of traction on a 10 per cent. grade. It had settled likewise that the motors we had were altogether too small and too light, because they were hotter perhaps than the furnace in an electric welding apparatus. On getting to the top we thought the best thing we could do was to stand still a little while. I remember one of my assistants, Mr. Green, was with me. I said to him: "Green I think we better send for some instruments, I think a little accident has happened to one of the machines." So we laid down in the bottom of the car until he brought those instruments. They were four strong mules for it was necessary to get that car back into the car shed that night. As I say, we are indebted very much to Providence, skill and energy for the success of road. That fact brought me face to face with the fact that it was necessary to make a complete change on sixty machines in Richmond in the matter of gearing. I was thoroughly at a loss what to do There was no factory that I could go to to get them built excepting one and that was the shop of Brown & Sharpe in this city. I said to the foreman, "We have met the worst obstacle I have ever seen in Richmond. We have got sixty cars we are under contract to run If we fail there it will delay the electrical development in this country; we likewise personally will go up. Now, I said I have got everything at stake, My associates have got every dollar at stake. The electric railway in this country is liable to be at stake. I said the road has got to go and go it must Will you do for me what I ask and put as many men and as much money and material at my command for twenty four hours a day as will be needed, until I recover the position we have lost?" He said, 'I will." They went to work and made probably the most difficult piece of gearing they were ever called on to make. In the course of four or five weeks we started again in Richmond on the 2d of February, 1888. The gearing had all stuck for lack of oil. Then the next thing we found was that the armatures were too large and so we had to resort to electrocution—we had to cut off their heads. We were using a 450-volt grounded circuit. The machines were covered with water and mud. Every field magnet had been wound and rewound three or four times. Our next experience was that our commutators were going to pieces. We had tried no less than sixty-five different kinds of trolleys and had not got one that would work reasonably satisfactorily. We were attempting to run motors in both directions and with a brush that was difficult to handle, and after trying a great variety of brushes we finally settled upon square bars of brass about three-eighths of an inch square and every time a car would go through the street you could see a shower of brass dust, so that we had the whole road marked from one end of the town to the other with a sort of golden path Subsequently we adopted the use of carbon. That inside history of some of the work at Richmond has of course not ordinarily been told. I think the time has come now when there is no harm in its being told I think that people would have looked on electric railways as out of the question if they had known of the straits we were going through. I see a representative here of an enterprise and industry with which we had some conflicts—the Bell Telephone company. I have heard since I have been here a criticism that I should have been an advocate of an overhead wire—one only remember—and had taken upon myself to get out an injunction against the Metropolitan Bell Telephone company of New York. About two or three weeks ago we had a very providential storm and in what I considered one of the most beautiful portions of New York there was a magnificent line of poles with 170 beautiful wires in all directions and one to cap them making 171 wires. A flaky fall of snow occurred and we found this army of poles lying flat in the street. We thought that the telephone company had so well built its line that Providence never would aid us. But we immediately had a meeting of property holders and by the next morning we had an injunction against the erection or maintenance of any poles or wires on the street. I have been somewhat criticised, but I think it nothing more than turning the tables on the company which for the past two years has been so successful in sitting down on the infringers of its patents. And I think the public has some reason to be satisfied, because the grounded circuit telephone is very largely disappearing from use and that more perfect telephone service is being adopted and sixty per cent. if I remember rightly, of the lines in New York City are now underground and we hope to see the balance of them there. As to the future of the electric railway I heard with some interest what Mr. Monks stated. His objections to the double equipment have been based somewhat upon the cost. I think we all know the experience the electric railway apparatus has gone through and none of us can doubt from the experience the electric railway apparatus has gone through that it is going to be made more simple, lighter, stronger, more reliable and at much less expense; so that the objection which he raises, I think, is not entirely a sound one. It is based upon past results, not upon future promise. The gearing of the present motor will disappear from the electric motor of the future. It will also be an electric motor driven direct without any reduction whatever. Its revolutions will be coincident with the revolutions of the wheel. The day of no gearing is fast approaching and those who have had experience with gears can surely feel encouraged by that fact. Of late I have been in exactly the position of Mr. Thomson where the infant swallowed up the larger specimen, and I have also been in the position where the infant got very thoroughly swallowed up. But the next electric railway problem in New York City—the question of rapid transit, is coming to the front. That we shall have there electric railway transit I think no man who knows the future of this industry will doubt What form it will take no man will tell. While I am an advocate of one wire if necessary overhead I am an advocate of everything being put underground as far as possible. I do not believe in the theory of God's free air in New York City when the air is monopolized by three things—buildings from ten to fourteen stories high, the elevated railroads and the Bell Telephone company But I believe in God's free earth where we can go independent of grades and independent of weather conditions. We have a most remarkable example of the perfection of that operation in London. I had the pleasure of visiting the City and South London Railway under the guidance of Mr. Hopkinson the engineer, and I told him there could be no question of the success of that enterprise. I think information since received of the progress has fully justified that prediction.

MR. WEEKS: It has been my experience in meetings that there are always brethren who require a little coaxing and I rise to ask from you the privilege of the floor for a gentleman from Chicago whose modesty, characteristic of the city from which he hails, forbids him to rise and ask that privilege for himself —F. S. Terry.

MR. TERRY: I thought at this time a few remarks on the preliminary organization of the National Electric Light association would perhaps be appropriate and interesting and I will occupy your attention only a very short time. In the latter part of December, 1884, George S. Bowen made the suggestion of calling the electric lighting companies doing business at that time together, and, with them as a nucleus, to form an organization national in its character and following the plan of the Gas association. This suggestion was made to several of those interested in electrical matters in Chicago, and it was finally decided, after many futile discussions, to call a meeting to perfect the necessary plans for such an organization, and a date was decided upon for this meeting. There was but little interest displayed in the matter however, and so few were present that nothing was accomplished and it gradually became understood that the proposed plan had fallen through. In the early part of February, 1885, the subject was again revived, and sufficient interest excited so that a meeting was held, eight or ten being present. I give the names from memory and my list may not be entirely correct: George S. Bowen, C. C. Warren, M A. Knapp, William A. Hammond, E A. Sperry, W. K Stiles, W. A. Kreidler and myself, all of Chicago. At the meeting it was decided to issue invitations for a convention to be held in Chicago and a committee on invitation and arrangements composed of George S. Bowen, E. A. Sperry and myself, was appointed. Of electrical journals the first to take notice of the National Electric Light association and to publish the call for a meeting in Chicago was the *Electrical Review* of New York. The only meeting of the committee of arrangements was held at the office of the Electrical Supply company then located at No. 175 Lake street, Chicago, at which the form of invitation was arranged and at which it was decided to correspond with some of the principal electricians of the country, requesting them to be present if possible The details incidental to preparing and issuing the invitations as well as the correspondence in reference to the papers were left to myself. As there was at that time no directory or list of electric lighting companies, we were obliged to depend on the books of the Electrical Supply company for our list of names and to more fully cover the field we took in addition to that list the cities in the United States with 20,000 inhabitants and over In many cases we found it necessary to direct our invitations to the "Electric Light company" that we thought might be located in each of these cities.

We entered into correspondence with Thomas A. Edison, Charles F. Brush and Elihu Thomson, requesting them to attend the convention and received replies from all three stating that they would be unable to comply with our request.

About February 18, 1885, a meeting was held at the Grand Pacific hotel, Chicago, and George S. Bowen was elected temporary chairman, and afterward the organization was completed with J. Frank Morrison as president. While during the preliminary work we had much hope and some idea that certain good results would attend a conference of all those interested in electric lighting, none of us, of course, realized the extent of the benefit which would ultimately result. At that time each of us was interested in our object of organizing a national association as we believed that it would be a good thing and of mutual benefit to all, and it seemed necessary that some one should start it. What this association has developed the constantly increasing interest excited by the present National Electric Light association and its increasing scope of usefulness, can bear witness.

DR. MASON: I suggest that if any members of the association have valuable reminiscences that they put them in writing and hand them to the secretary that we may have the benefit of them in the report of our proceedings. The convention then adjourned until three o'clock.

AFTERNOON SESSION.

The convention was called to order by the president who announced that invitations have been received from the Providence Steam Engine company and the Providence Young Men's Christian Association, both of which were accepted.

THE PRESIDENT: The first item on our programme this afternoon is a paper by Prof. Elihu Thomson on "The Electric Arc and its Use in Lighting"

PROF THOMSON: My object in selecting the title of this paper was to have a brief review and go over the subject of the electric arc, and review some of its important features, particularly as applied to lighting, and, at the same time, to study it in a scientific manner, so far as was possible within the limits of the time. On getting well into the matter I found that it was a much larger subject than could be handled in a single paper, and, as a consequence, I had to cut a good deal of it short toward the end.

Prof. Thomson then read the following paper:

THE ELECTRIC ARC AND ITS USE IN LIGHTING.

BY ELIHU THOMSON.

It is curious that notwithstanding the fact that as a source of illumination the electric arc has been known since the beginning of the century, the scientific study of its nature has been but little pursued It began to be known as a sort of a scientific curiosity, being set apart as one of the many phenomena observed in the use of powerful batteries It was not till about twenty years after its discovery by Sir Humphrey Davy that any proposals were made to use it in lighting, and subsequently for many years it was occasionally employed either in lecture demonstrations or in obtaining an intense light for some special purpose.

The efforts to use it in lighthouses led to the designing and construction of machines on the magneto-electric principle to replace the cumbrous and costly batteries otherwise required. I remember vividly the hours of labor and time necessary to prepare a battery of forty Bunsen cells for use in working a single small arc light for, at most, two or three hours. But I remember far more vividly the suffocating fumes and risk of acid spilling, with accompanying ruin concomitant on the taking down of a partially exhausted battery. Even to work with the arc for an hour or two was, however, adjudged a sufficient compensation for the disadvantages in obtaining the current. All this has, however, been changed, and the past ten or fifteen years has made the arc as a source of illumination one of the indispensables of a progressive community. Instead of the original little short sticks of boxwood or charcoal used as "points," which were only "points" because it was not expected that the arc would be burned for more than a few minutes without exhausting the battery, there came later on the little hard carbon sticks about two inches long and 3-16 inches square, sawn from hard gas retort carbon, or from battery plates, and, lastly, came the moulded and forced carbons made from a paste in a powerful press, millions of which are now required every week to keep the lamps at present in use supplied.

The charcoal points of Davy were touched together horizontally after attachment of the wires to the battery, and were then separated. The stream of hot flames which followed or joined the points being deflected by air currents took the form of an arch or curve which gave the name to the phenomena. Even with one carbon directly over the other, the curved form of the stream is the rule when the carbons are widely separated. Day's original experiment was made with a battery of 2,000 cells, with zinc and copper plates about six inches square, the exciting fluid being very dilute sulphuric and nitric acids.

Day's description is as follows: "When pieces of charcoal about an inch long and one-sixth of an inch in diameter were brought near each other (within the thirtieth or fortieth part of an inch) a bright spark was produced, and more than half the volume of the charcoal became ignited to whiteness; and, by withdrawing the points from each other, a constant discharge took place through the heated air in a space equal at least to four inches, producing a most brilliant ascendant arc of light, broad and conical in form in the middle." This was evidently a long-flaming and horizontal arc. I find this form shown in a book published as late as 1846, "Davis' Manual of Magnetism" Indeed I know of no more forcible example of the persistency of old ideas than is afforded by the accounts given in the books concerning the nature of the electric arc. The persistence of old cuts is also equally exemplified, even down to the latest publications, giving pictures of the electric arc. The carbons are generally shown crusted over with dense masses of impurities melted into globules or adhering to their sides (Fig. 1.) Such figures would not now be recognized as resembling arcs formed with good, pure carbons, such as must be used for commercial results in arc work.

Figs. 2 to 4, inclusive, show the development at least in illustration concerning the electric arc.

Fig. 2 is from Davis' Manual, referred to.

Fig. 3 is one of the figures showing the arc, taken from Ganot's Physics, published in 1863, though the figure is from the 7th edition, 1886. It is virtually the former figure made vertical.

Fig. 4 is a figure of a modern arc

In regard to the ideas put forward as to the nature of the electric arc there is even a wider divergence than in the figures used for representing it. But these views are re

markable for their general inaccuracy or crudity and evidently have been handed down with modifications. Few of those who have written about the electric arc, at least in the text-books, seem to have had the courage to look at the arc, or they may have seen it "through a glass darkly, and not face to face." It would require too many and lengthy quotations to give these various views. In most of them the light of the arc is attributed to intensely-heated carbon particles transported by the current from one pole to the other. In most of them the idea of carbon vapor as a possible factor never seems to have arisen. Others attribute the arc to the heated air between the carbons which carries carbon particles, some of which are burned.

The following quotation from a book on electric lighting, published in 1884, is a type of many such accounts:

"In arc lamps, as we have already stated, the resistance which converts the current into heat is that of the heated

FIG. 1.

air between the ends of two carbon rods, from one to the other of which the current passes. The light is produced by the incandescence of the ends of the carbon poles, and of the minute particles of carbon which become detached and float in the heated air between them. The heated air containing the particles of carbon forms what is called the electric arc."

Here the heated air and carbon particles floating therein are definitely stated to form the "electric arc." Nothing is said of carbon vapor having anything to do with it,

Even the statement that the positive carbon burns twice as fast as the negative is very frequently found unqualified in any way whatever. The experience of the lamp trimmer is, I need scarcely say, not in accordance therewith, the fact being that the rate of consumption even in direct current arcs with the same size carbon in both holders varies sometimes quite widely from the proportion stated. However, we shall make better progress if we discard at once the older notions, and, adhering only to that modicum of truth which often accompanies error, supplant the error by the results of our own observations and experiments. My endeavor will, therefore, be to state as briefly as I can such views of the nature of the electric arc as seem to be borne out by observation during many years, and under greatly varying conditions of its production.

Let an attempt be made to separate any part of a circuit

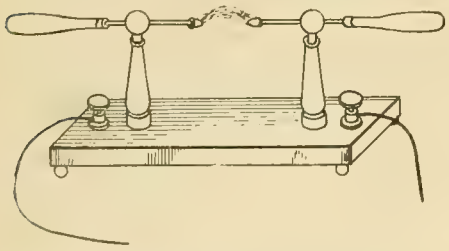

FIG. 2

in which the current is maintained by a sufficient e. m. f. or potential, and we find that if the separated ends are moved quickly we get a flash or spark of varying length which becomes a flame of great heating effect if the current be of high rate of flow. If the separation of the two parts of the circuit be made slowly a continuous flame or discharge will take place between the ends if they be not too widely separated or so widely separated that the potential or pressure of the current is not sufficient to force current across the space. With considerable potentials and heavy currents a space of many inches may thus be bridged. Whether the separated ends be of iron, copper, carbon, platinum, zinc or other conductor the hot discharge is still formed. Therefore while the electric arc is generally spoken of as that flux occurring between *carbon* ends separated, of course it cannot be so limited and we frequently, therefore, refer to copper arcs, iron arcs, carbon arcs, to distinguish one from the other. What then is the arc so formed? Is it heated air between the ends separated containing detached particles of the conductor in process of carriage, as was apparently thought for a long time to be the case? No, the arc proper is composed of a stream of vapor arising from the actual boiling or vaporization of the solid or fused ends of the separated conductors. In so far as the surrounding air mixes or combines with this vapor stream it is modified by the presence of oxygen and nitrogen, but the air or any other gas is not essential to be present and is merely incidental to the formation of the true arc stream in air. Indeed, it may seem strange to some to speak of vapor or carbon, copper, iron, platinum, etc., but their production is merely a question of temperature in any case. In the electric arc there is a real distillation of the conductors forming it and this accounts for the variation of color and temperature to be found in different arcs. The copper arc evolves a peculiar green light which is exceedingly trying to the eyes as those who have experienced its effects well know. Zinc gives a whitish blue, while the carbon arc proper is purplish in tint. The arcs from various metals give in the spectroscope the characteristic lines of the vapor of each metal.

As a curious incident, showing the presence of the metal vapor in the arc, I may mention the fact that when by accident a person has had a portion of his clothing bathed for an instant in a heavy copper arc caused by a short circuit of heavy current mains there has been found a considerable deposit of copper, enough, in some cases, to give the reddish color of copper to the surface bathed, which if moistened turns green by oxidation. It also gives a deep blue to dilute ammonia in which it is washed, thus showing the presence of copper. In like manner these metallic arcs will give a deposit of the metal on cold surfaces which they touch.

It appears to be the positive pole which gives out the vapor stream. With carbon the positive vaporizes steadily and is consumed much faster than the negative. In the use of the arc, however, for lighting we have learned to distinguish what is called a "short arc" and a "long arc" system. In "short arc" systems the carbons are burned much nearer together than in the "long arc" systems. Let us suppose the case of two carbons touching each other with a current passing and then that we very slowly separate them, stopping to observe effects. When the contact is light before actual separation, a visible heating of the meeting ends is seen. On attaining a small separation the space between seems filled with hot vapor and we have a short arc where the separation is perhaps not over 2 or 3 one-hundredths of an inch. There is also noticed an active transfer of carbon from the flattened end of the positive and a deposition of carbon on the end of the negative carbon. This deposited carbon takes the form of a mushroom, and after a time, breaks off. Meanwhile combustion goes on at both poles and wears away the sides of the positive carbon while the transfer of carbon wears away its tip or crater. The burning also wears away the negative at the sides, while the tip is built up by the mushroom deposit from the arc. But the cutting in of the negative finally severs the mushroom tip and it falls away. Hence both carbons are eventually consumed. To develop a short arc there is required a little over half the potential that is needed for a "long arc," or about 25 volts more or less, and therefore to give out equal heat energy in the arc the current must be double in the short arc over what it would be in the long arc. The short arc is subject to the objection of a continual frying sound emitted, and great variations of luminosity; it requires a very dense and hard carbon to conduct the current without great loss, and involves line loss of at least four times the amount with the long arc if equal gauge wires be used.

In fact while in the past such arcs were common, their number is diminishing, as they are being replaced by the more efficient and completely developed arcs called "long arcs," which are so called to distinguish them from the "short arcs." Returning to our separating carbons we find that as the space or arc is lengthened from the short arc condition we pass a stage of great flickering and unsteadiness and a fluctuation potential between the carbons, and then reach the stage of the long or quiet arc. With ten amperes the separation may now be about 1-16 to 1-10 inch or more. Smaller currents require less separation and larger ones an increased separation At this stage the arc is quiet, with good, pure carbons very steady, and the potential difference remains at about 45 volts, if, of course, the carbon is properly fed to make up for combustion. The perfect arc is really a beautiful phenomenon. While the positive carbon still loses by volatilization from its tip or crater and by combustion from its sides, the negative gains no deposit but wastes at a less rate than the other, and by combustion only. The carbon vapor carried off from the positive is consumed by the oxygen of the air before it can deposit on the negative Hence the outer zone of flame which can easily be distinguished from the central zone or arc flux proper, is probably a zone of combustion similar to that existing in ordinary flames The removal of carbon by vaporization from the positive end, gives rise to the crater or cup which is so prominent a feature of carbon arcs produced by continuous currents. The size or area of the crater is a rough measure of current strength but varies with different qualities of carbon. With very long arcs the crater or hollowed end disappears and the ends become rounded. A well formed crater with the arc of flame confined thereto means usually a steady light, since the chief source of light in an electric arc is from the positive crater which shines like a diminutive sun and represents the hottest part of the arc. The vapor light proper or flame light is comparatively very feeble and of a purple quality in air. Hence the arc light is as truly an incandescent source of light as is the incandescent carbon filament, with the difference that to run the latter at the temperature of vaporization or boiling point of carbon, so to speak, means instant destruction, while by the necessities of the case the light obtained from the arc is chiefly that emitted from a surface of carbon at its temperature of boiling, or more correctly of sublimation at atmospheric pressures. This temperature is exceedingly high, and accounts for the well-known superior economy in light production of the arc over all other kinds of lighting.

The temperature of the positive carbon crater is so high that the carbon exists there in a soft or plastic condition capable of receiving an impression like putty I have proved this with very large arcs of 150 to 200 amperes by suddenly forcing the carbons together when the current had been cut off and finding that they would fit each other perfectly, the negative impressing its form on the positive crater.

As an interesting fact in this connection I may state that I have been able to bend carbon sticks of 3-16 to ¼ inch in diameter by passing current through them of sufficient amount to almost vaporize the sticks and cause them to emit an intensity of light approaching that of the arc

These facts would point to the possible fusion of carbon into liquid carbon at arc temperature under a high pressure of inert gas. No one has as yet seen carbon in this liquid condition, and the electric arc alone has made us acquaint-

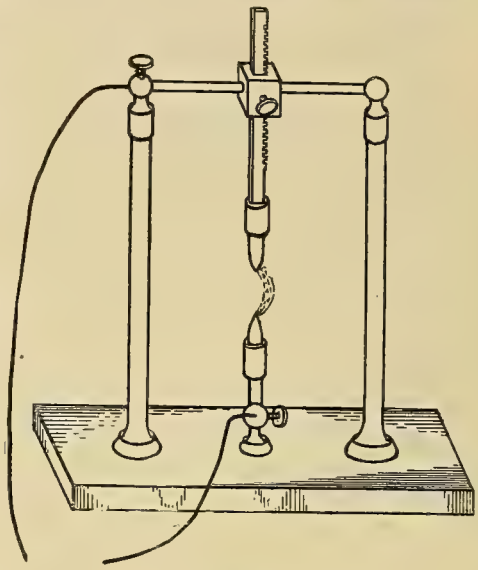

FIG. 3.

ed with carbon vapor. One cannot fail to be impressed with the fact that the conveyance of carbon in the arc has a striking resemblance to a plating process where metal is taken up by the bath from the positive plate and deposited on the negative. In the arc the hot vapor stream of flame takes the part of the bath and probably acts by molecular interchanges of carbon atoms in molecules of carbon to cause the transfer which occurs, just as in the plating bath the molecules of the plating compound are polarized and allow atomic interchange which results in conveyance of metal through the bath.

Another curious fact in relation to the arc is the distribution of potential in it. Dr. J. A. Fleming has recently shown that the difference of potential between the positive carbon and the arc flame is about forty volts and the few volts which express the difference between the flame and the negative make up the total potential say forty-five

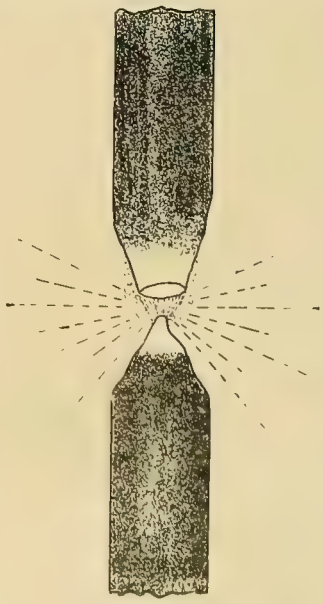

FIG. 4.

volts. Hence the real work of the arc is not in the flame, the energy is not used in overcoming flame resistance, but chiefly in vaporizing carbon in the positive crater. It is certainly not strange that with forty volts and, say, ten amperes of 400 watts expended virtually at the crater surface of the positive carbon the temperature and luminous effects should there be so great.

The distribution of potential in the arc just noted was

also brought out about the year 1884 in some testimony in an interference in our Patent Office concerning an arc lamp cut-out which I had invented and which took advantage of the potential differences between the carbons and the arc flame to cut out the lamp when the arc was too long. It is of course well known that the value of an arc light for general illumination is greatly enhanced by the fact of the distribution of light being mainly in a downward direction in continuous current arcs. This of course follows from the fact or the positive carbon crater being above, such crater being the part from which most of the light comes.

This matter has been quite thoroughly investigated and many diagrams of distribution are to be found in the literature of the subject, as published from time to time. They show that with the long arc the maximum intensity of light is from 40° to 60° downward from the horizontal and that the horizontal intensity is generally much less than one-half as great, while of course the intensity diminishes above the horizontal direction and ultimately becomes zero before reaching the upward vertical direction. In like manner the approach to the downward vertical from the direction of maximum intensity is attne[illegible] with similar rapid diminution.

The spherical candle power of arc lights would therefore be only a fraction of the rated candle power which is generally taken at the maximum light obtainable in the best direction from the particular arc or kind of arc in question.

For this reason the term 2,000-candle power arc has little significance as indicating the illuminating power of an arc. It is a conversion only and a poor one at that It is now generally taken to mean an arc with ten amperes and not less than 45 volts potential difference between the carbons or a 450 watt arc The quality of the carbons will determine whether the 450 watts will be expended in obtaining the most light or not or whether that light will have gave accuracy of form and cheapness. To one familiar with the former cost of carbons for battery arcs the reductions are very striking: Carbons 3 1-6 inch square cost a number of cents an inch before the year 1878.

Another important matter in relation to carbons is that the size of section or diameter must be proportioned to the current used. Where attempts have been made to prolong the hours of burning of a carbon by enlarging its diameter beyond certain limits, it has resulted in injury to the character and distribution of the light. Large diameters of carbon may burn too blunt to let the light out between them.

Likewise, where attempts have been made to prolong the hours of use by employing a harder or denser carbon than before it has frequently been found that a sacrifice of light has been incurred, rendering the results much less satisfactory.

One of the chief obstacles to the employment of quite small arcs with currents of three or four amperes is the difficulty of obtaining suitably uniform carbons.

Arcs of even as low as two amperes at 45 volts are easily produced, and such small arcs might even have commercial utility if the difficulties in relation to carbons were removed. An arc consuming 90 to 100 watts means of course about 7 or 8 to the electrical horse power.

On the other hand, very large or heavy current arcs are difficult to control. They are apt to be unstable at times, and when they get to hissing, or rather roaring, it is difficult to restore quietness and steady action. The introduction of cored carbons for the positive has, however, done much to remedy the difficulty, and indeed to render it possible to obtain very uniform results from arcs in general wherever such results are indispensable. The introduction of the central soft core into the carbon seems to locate the arc centrally, hold it from fluttering or shifting its position on the end of the positive; in other words, the core fixes as a metallic arc, and distils and condenses on the surfaces near at hand.

Before passing to the consideration of the running of arc lamps in series, or in multiple, and the conditions to be fulfilled in each case, we may state that although in ordinary cases an arc is formed by a single pair of electrodes or carbons, and by a single circuit current, compound arcs, or arcs produced by combinations of two or more currents with three or more electrodes are possible. I am not aware that any others than myself have experimented in this direction. I have, however, produced lights with two positives and one negative, with one positive carbon or crater and two, three or more negatives and with two positives and two negatives. I have caused arcs to cross each other, as when four carbons are used, pointing toward the center, the two pairs opposite being respectively connected with different circuits. In this way direct arcs have been, as it were, mixed with alternating arcs and a curious compound effect produced by crossing two arcs made with two alternating currents the waves of which are displaced in phase. Without going fully into these experiments I will present figures showing two good examples. Fig. 5 is formed by two currents sent into a positive *P* and dividing after passing the crater into two streams going to the two negatives. In this case the positive crater is fully exposed horizontally and gives a most intense light in a direction forward. Such an arc is well adapted for projection by mirrors or lenses.

Fig. 6 shows the arc formed by crossing two alternating currents out of phase. In this case there is at successive times an exchange of current between all four carbons in varying directions so that the arc flame becomes, as it were, a ball or disk of very hot flame supported by the four carbons These experiments have not been fully described as yet, owing to the lack of time, but they show very well that even when we have fully studied the single, simple arc we will not then have exhausted the subject as

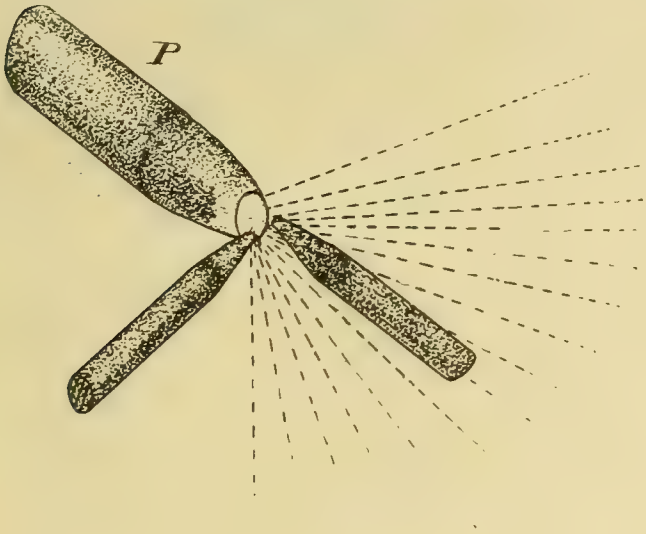

FIG. 5

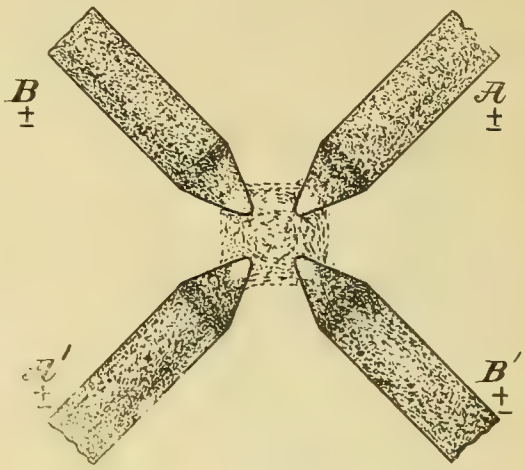

FIG 6.

a maximum intensity at one angle or another within certain limits.

When arcs are operated on by alternating currents, the effects mentioned are only partially exhibited and the phenomena of the crater are of course masked or obliterated on account of reversal of function of the carbons. Unless the alternations are rapid such arcs are liable to extinction at the zero points of current, particularly when run in a draft of air. A strong draft of air or a displacing magnetic field may of course so disturb an arc as to cause its extinguishment.

In the early years of the growth of arc lighting as a means of illumination the effects obtained were not of the best. Unsteadiness was the rule, and it required much persistent effort to discover the causes, and find the remedy.

The prominent defects were, and we may add are still, hissing, sputtering, flaming and general unsteadiness. Hissing or frying comes of course with too short an arc, and may be connected with too vigorous vaporization. They may also be due in some cases to a carbon of too coarse a grain. Sputtering may arise from impurities in the carbons and flaming from too long arcs, from impure carbons, or from carbons insufficiently baked and containing unexpelled gases. Running an arc at a length between the long arc condition and the short arc condition may cause great unsteadiness of light There is in fact a critical point in the length below which there is a considerable fall of luminosity and a drop of nearly one-third of potential As an arc lengthens by combustion of its carbons beginning below this critical point, great unsteadiness will be manifested on arriving at the critical state, and a little longer arc brings about a sudden and very marked increase of potential, of illumination and of steadiness.

Any observer may easily detect these conditions without special effort. The earlier carbons used with arc lamps in the United States were both bad conductors, impure and badly made. Copper coating was a necessity. French or Carre carbons were much better, but were too costly to import. The use of the petroleum carbon or the carbon obtained by the carbonization of the tarry residue left in the distillation of crude oil, made a wonderful difference in the purity of the carbons, and improved machinery the position of the crater, and so benefits the light.

It follows from the fact that the voltage required to sustain an arc with large or small currents ranges about 45 to 50 volts that the larger the current passing in an arc the less its electrical resistance. Hence well developed arcs with 4 amperes will have about 11 ohms, with 10 amperes 4.5 ohms resistance, and with 100 amperes .45 ohms. This fall of resistance with increasing current is easily explained by the broadening or thickening of the arc stream and the widening of the crater on the positive carbon The widening of the crater also gives increased illuminating power without increase of temperature. It is probable that the actual crater temperature is as great in the small arcs as in the large ones, in fact this is implied by the quality of the light remaining the same. Nevertheless, the larger the arc the greater the economy, or the greater light giving power per unit of energy. This would naturally be expected as the concentration of heat and lessened chances for escape of heat by convection and conduction would conduce to that result

The fall of resistance with increase of current has an important bearing on the construction of dynamos for arc lighting and the running of lamps on constant potential or incandescent circuits; and will be referred to later on. Attempts have been made at various times to save carbons in arcs by excluding the oxygen of the air which is the cause of their waste or consumption by burning. The gain has not apparently compensated for the disadvantages incurred, particularly as the total exclusion of oxygen means that the carbons become blunt. They would be prevented from pointing themselves or acquiring tapered ends by burning, a condition essential to good working and distribution of light. Even when the arc is formed in a vacuum the carbons, though not burned, are slowly consumed, and carbon deposited as a soot on the sides of the vacuum chamber, an effect consequent upon the vaporized carbon in the arc being carried off and condensed again as soon as the vapor escapes the heat of the arc stream.

In fact I have found it possible to coat objects on the inside of a bulb with silver or other metals volatilized suddenly by arcs in vacuo, and have obtained in some cases coherent brilliant deposits. The metal is raised in vapor these compound arcs may be varied in character to a great extent and present new effects.

In regard to that portion of our subject which concerns the use of the electric arc for lighting, it is true that there is a wide field before us. I cannot hope to do more in this paper than to outline in addition to the considerations already alluded to some of the other prominent features of the subject. It is well known that by far the larger proportion of electric arc lights in operation is run on circuits of constant current, the light being in series.

If arc lamps be connected in parallel, as on low potential incandescent mains, special devices are required to keep the current supplied to each lamp at the right amount.

It may appear at first to one who has not had occasion to closely study these matters that, given a constant potential circuit of fifty volts, arc lamps requiring fifty volts could be connected in multiple or parallel without difficulty. The fact is, however, that the condition of electric arcs being supplied with a constant potential involves a theoretical impossibility Theoretically such an arc would take an infinite current and energy Practically the current in an arc with constant potential becomes very heavy, and if the carbons be separated to cut the current down as by a lamp magnet mechanism, a condition of fluctuation and instability results. This is a direct consequence of the fact before stated that the resistance of an arc is not like a wire resistance but falls with increase of current and vice versa. For stability the resistance should not be dependent wholly on the current passing. To remedy the instability a resistance known as a "choking coil" or "sluggishing coil," is inserted in the arc branch and the potential raised say to 65 or 70 volts. Under these conditions, that is with a resistance taking up 15 to 20 volts in series with the arc, it may be run in multiple with incandescent lamps or with other arcs. There is, however, a waste of energy equal to the product of the current strength by the loss of potential, 15 or 20 volts, in the resistance. A great deal of useless experimenting has been, and probably is yet carried on with the vain endeavor of getting rid of the resistance or choking coil in this case, but the difficulty is inherent in the nature of the arc, the relation of resistance to current giving rise to instability of current in the arc.

Similarly, not all dynamos, even if of sufficient potential, will run arc lamps in series. Arc machines require special properties or the current will be unstable and the lights will fluctuate or "surge," as we sometimes call it, possibly to an extent amounting to extinction and relighting occurring at short periods apart. This action like the other is dependent on the relation of current and resistance as inherent in electric arcs, and the series of light would in each case require dead resistance up to a certain amount in circuit to render the current stable. Then whether a series be operated or a single arc be operated, either a dead resistance must exist in circuit or the current supplying apparatus must have special properties. The arcs produced from batteries were stable because the resistance of the battery itself was sufficient to ensure this. Arcs are not stable as fed from accumulators of very low internal resistance unless the arc is one of enormous current.

Briefly, the property required to be possessed by an arc dynamo is that as its current rises above the normal, the electromotive force must fall, as the current diminishes to a little below the normal, the electromotive force of the dynamo must rise. It is not sufficient to secure this changing e.m.f. by regulators, as they are generally behind time for causing stability of current, however well they may operate to regulate for varying numbers of arcs in the series to be supplied.

The properties of dynamos are sometimes expressed by what are called "characteristics," or "characteristic curves," obtained for example by laying off vertically or on the ordinates the electromotive forces corresponding to varying currents given out by a machine, which currents are laid off horizontally or as abscissae. In arc machines the curve so produced is convex upward, and droops at its outer end *b*, Fig. 7. Assuming normal current at ten amperes and an e.m.f. of 500 volts at eleven amperes, the e.m.f. may have fallen to 420 volts, and at nine amperes risen to 530. We would then be working on the "droop" *a* to *b* of the curve when at ten amperes; and such a machine is stable as to current for running arc lamps. There appears to be required not merely a droop in the curve for securing stability but more than a certain amount of rate of droop or dip. If the line could be made to droop or dip vertically after passing the normal current the machine would regulate without a regulator or be a constant current automatic machine.

In what respect, then, do arc dynamos differ from others to produce this relation of droop in the characteristic curve? Without doubt the effect is mostly due to the reactionary effects of the armature on the field, which effects in arc machines are made greater than in others, and the field magnets meanwhile are frequently saturated magnets, so called, and not greatly sensitive to the current in their coils. The armature of an arc machine is indeed so powerful an electro magnet that it is able to control the magnetism of a portion of the field in which it turns. A sort of balance of magnetic forces is established at certain portions of the field which on an increase of current in the armature produces polarity opposing the field polarity at the portions mentioned, such as will cut off some of the lines of magnetism from entering the armature core and so lower its electromotive force; while a lessened current in the armature will weaken its polar portions and an increased number of lines will enter the armature core from the field and so increase the electromotive force at the brushes of the commutator. In Fig 8 the portions at *KK'* are those at which the balance or conflict of opposing poles of armature and field magnet exist, namely at those portions near the diameter of commutator or position of the brushes on the commutator.

Could the droop or fall in the characteristic curve be made a vertical, as stated before, then we should have a self regulating machine not needing a regulator to preserve a constant current under all loads. This condition is more easily arrived at in alternating machines, one of the first, if not the very first example of which is found in the Chertemps Dundee machine, which was tested by Robert Sabine, as described in Dredge's Electric Illumination Vol. 2, 1885. This machine had the remarkable property of permitting ten arc lamps to be cut out or put into its circuit in series in any way without causing a variation in current strength of more than ten per cent The interactions occurring between the armature and field accounted for this regulating property. In these cases the armature currents react upon the field with a force producing at times a balancing of magnetism between the two. The distortive power of the armature upon the field is made very great, which amounts to the same thing.

In the recent alternating machine for constant current brought out by Wm. Stanley, we have an excellent example of the application of similar principles of construction, together with the difference that the arc lights which were fed direct in series from the Chertemps Dandeu machine, are run from transformers with the primary coils in the Stanley apparatus.

The relation of current to constancy is, however, in continuous current dynamos for arc lighting generally effected by regulators, as they are called, which so alter the dynamos on a slight increase or decrease of current as to raise or lower its electromotive force according to the resistance in circuit or speed.

In one form of regulator the effect is obtained by changing the field magnet strength by automatic mechanism, weakening the field when lamps are cut out and strengthening it when lamps are added to the circuit. Another means of regulation is the rotation of the commutator or brushes so as to take current from positions corresponding to increased or decreased electromotive force in such a way that the current obtained is constant. The former method first appeared in the Brush arc apparatus and the automatic commutator brush movement in the Thomson-Houston machine. The latter method renders the machine completely automatic under variations of load while in the former there still is required a manual spark adjustment of the brushes as the field magnet is altered in force under different loads. The two methods were subsequently combined by the writer in conjunction with E. W. Rice, in such a way that the necessary brush adjustments were made automatically at the same time with the variations of the field under different loads. This combined method has been used for some time past in the Excelsior machines constructed under the patents and designs of Mr. Hochhausen, whose name is so well known in connection with arc lighting and plating and other electric apparatus in this country. On account of the fact that with the addition of arc lights in a series a higher and higher potential difference is required at the terminals of the dynamo, it becomes a question how far this increase may promptly be carried. It is not unusual in the present practice to run from fifty to sixty lights, in a series each demanding from forty-five to fifty volts, or a total of say three thousand volts. In going beyond this amount the difficulties of insulation are greatly increased as well as the dangers of high potentials, while the consequent risk of breakdowns resulting from failure of insulation or leakage is often sufficient to offset any saving of wire conductor that might be obtained by running more lights in series. Instances have occurred in which with ordinary wiring and precaution 120 to 150 arcs have been run for days together, but such a practice is to be condemned as involving hazard of all kinds.

It has been supposed by some electricians that there existed a peculiar fitness for arc lighting in series in dynamos of the open coil type, such as the Brush or Thomson-Houston, over those of the closed coil types, such as the Gramme or Siemens forms. While, personally, I have never been prepared to admit this peculiar fitness, constructors of machines of the closed coil types have certainly succeeded in removing any doubts on that score. J. J. Wood has, in building his form of Gramme machine up to the highest capacities for series work, taken a leading position in this respect. In fact the simplicity of the commutator and the ease of insulation of machines of the open coil type undoubtedly rendered them more capable of retaining insulation at high potentials than the early commutators with numerous segments used on Gramme and Siemens machines, as such commutators were at first constructed. Likewise improved methods of insulation and winding have gone far to put both types of machine far in advance of what they were formerly. While on this subject of arc machines it may be well to say a few words as to the action of flashing which can occur in all machines of high potential under certain conditions. In the first place the term flashing, as here used, is not intended to refer to sparking at the commutator, but rather to a flash or continued spark carried over during revolution of the armature from one brush toward the other, either all around the commutator or part way only. This action occurs when any two successive segments in the commutator continue their discharge one toward the other over the insulating space between them during a considerable part of the revolution. An arc forms in the slots or between segments and moves with them. This action while not very damaging where the segments are massive and insulated with air spaces is more serious with insulation filling between the segments, as it is apt to cause a burning out and either short circuit the armature coil sections by connecting the segments or seriously roughen the edges of the segments and the face of the commutator.

Bad setting of brushes may both cause sparking as well as flashing; and dirt, in some cases, or too much oil, may cause it. Slipping of belts or sudden fluctuations of speed may also provoke it. Or a machine overloaded may flash by an opening of circuit due to too many lamps, the electromotive force required for which number the machine cannot maintain. The presence in a circuit of one or more lamps which do not feed properly may cause momentary cessations of current and flashing to occur, especially when the machine is carrying its full load. With all arc circuits there should, of course, be a surplusage of capacity on the dynamo, i. e., the machine should not be run to the limit of its electromotive force. It has become customary with the best makers to so rate this capacity that there will always be a margin of excess to meet contingencies. The line resistance may, of course, be, in the case of long circuits, such as to cut down to a considerable extent the working capacity or number of lamps in series which can be run from the dynamo, and due allowance should always be made for this resistance in estimating the true capacity. Instances are not uncommon in which by improving the contacts of switches, hangers, joints, etc., a gain of two or three lamps may be made in circuits of fifty or more lamps in series. An improvement in the insulation of a line will often have a similar effect in adding to the apparent capacity.

I had intended at the outset of this paper to discuss in a general way the question of the different types or classes of lamps used for arc lighting. It is a department of the subject which is of considerable importance, but I find that the paper has become too long already, and for the present I will simply allude to one or two general features. Concerning the manner of feeding the carbons the mechanisms in use may roughly be divided into clutch and gear mechanisms. Among clutch mechanisms we find certain well known forms, while the gear mechanisms best known are of the escapement order. Both types have undergone many modifications and combinations of the two exist.

Whether one or the other type is to be selected will depend largely on the conditions of use, assuming both to be equally well constructed and kept clear. Into these questions, however, we cannot now enter.

Arc lamps may also be divided according to the way in which the magnet system acts to control the feed of the carbon. Before arc lamps were run in series it was sufficient to have the controlling magnet in the main circuit and this was the case in almost all the older forms of lamp The Lacassagne and Thiers lamp of 1856 was a notable exception in that the control of the feed was differential or dependent on the difference of power between a main circuit coil and a high resistance shunt circuit around the arc.

I have, in fact, made an exact reproduction of the Lacassagne and Thiers lamp according to their patent specification and have found that its action is perfect when used in series with other lamps except that it requires to be helped to separate its carbons. If the carbons are quite pointed at the start even this is unnecessary as the points soon heat and burn away and form the arc. The feeding depends on the flow of mercury through a small valve which is adjusted by the differential magnet system, and the feeding is so continuous and imperceptible that the arc is beautifully steady and constant in length.

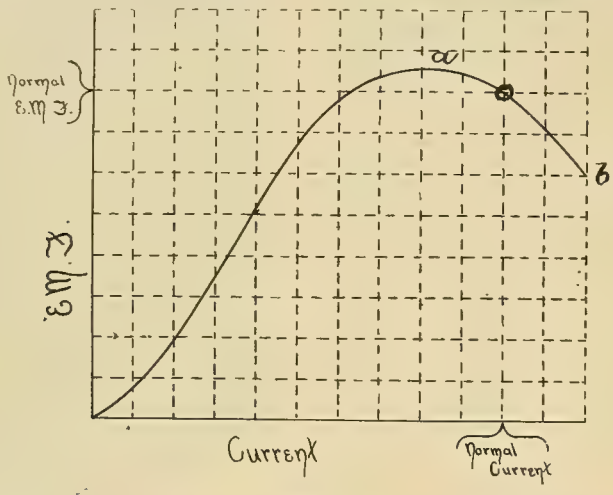

FIG. 7.

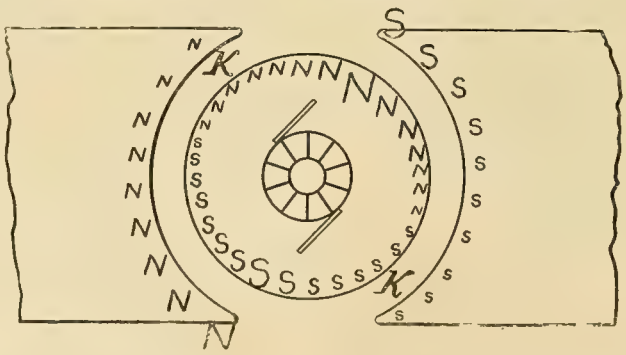

FIG. 8.

At the present time the differential lamp magnet system is of several kinds, according to the relative disposition of the main and shunt coils.

In the commercial Brush arc lamp they are disposed one over the other on the same axis and affecting the same magnetic cores. The only objection to this disposition, which has the advantage of simplicity, is that the shunt circuit can never act positively to feed the carbons or release the clutch or gear, but can only weaken the effect of the main coil or overpower its lighting or separating action on the carbons.

Other forms of differential lamp embody the two circuits acting on separate magnets pulling in opposite directions, the main circuit to separate the carbons and the shunt to feed them. In this case the action of the shunt is more definite and positive as it is not limited simply to overcoming the force of the direct or main magnet.

A third arrangement involves the application of the repulsive action of the two coils as when the direct coil is wound on fixed magnet and the other, or shunt, upon the feed controlling armature therefor and tending to cause repulsion of the armature from the main magnet. The arrangement is both simple and positive in its action.

The differential types of lamp act well when the circuit current is kept constant, and require readjustment generally for each change of current strength by which they may be operated. Hence, if a portion of a line be leaky the lights are apt to burn badly owing to diminished current, while the dynamo may be furnishing full current. Of course, such a line ought to be condemned and its insulation improved. Nevertheless I have frequently seen lights suffer from leakage on extended circuits in cities, especially in very wet weather. This is a state of things which the line superintendent can do more than any one else to correct, by attending to the correct disposition of the wiring, and its character as regards leaks.

The type of arc lamp in which the shunt magnet alone, controls the feed of the carbons is not sensitive to slight variations of current, but maintains a full, quiet arc with the current it gets. This is because the main current is not concerned in the feeding action, but the action is solely dependent on the potential difference of the carbons. Hence its behavior is on the whole more uniform than the differential type and within limits it does not require readjustment for different current strength.

This principle has been extensively introduced in the Thomson-Rice lamp of the Thomson-Houston company. In this lamp the carbons are separate at the start and are brought together on the first passage of the current, after which they separate solely under the influence of the shunt circuit magnet and the feed is likewise controlled thereby. The carbons in these lamps are not so apt to slide by or alongside each other by jarring when no current is on the lamp, as may occur, particularly with careless trimming in those lamps in which the full weight of the upper holder and carbon must be borne by the under carbon when the lamp is not lighted.

Arc lamps have been made with many variations in the magnetic arrangements controlling the carbons, a brief statement of some of which is as follows: Carbons lifted or separated by direct or main magnet; shunt magnet acting on a variable resistance to cut out the main magnet in feeding. Carbons lifted by main magnet as before and shunt acting to put the main magnet (made movable) into position for feeding.

Carbons separated by main magnet armature; shunt circuiting magnet acting to divert or shunt the magnetism of the main magnet from its armature.

Carbons separated by main magnet and shunt acting to free the carbon holder independently of the support given by the main magnet.

Carbon separated by a spring allowed to act by the main magnet lifting a weight which otherwise holds the spring from acting; shunt magnet acts against the spring to feed and regulate length of arc.

One carbon, generally the lower, separated by main magnet, while the other holder is released for feeding only, such feeding being under the control either of a differential system or a shunt magnet only.

Carbons separated by main magnet which lifts the shunt and its armature together, while the shunt magnet armature acting on the feeding mechanism controls the arc and feed of the carbons.

Carbon feeding mechanism independently attached to main magnet armature and to shunt armature, so as to receive opposite movements of separation and feed from each respectively.

Carbons separated by a feeding mechanism moved by the main magnet and fed by a further movement of said mechanism causing release or return of same under the accumulated force of both shunt and main magnets acting in the same direction.

Differential clock gear for separation and feed of carbons under control of the regulating magnet system either simple or differential. Some of the older clock work lamps embodied this principle.

Carbons controlled by armature of a small electric motor under control of a differential field which turns the armature in one direction for separating and the other, or reversed direction, for feeding the carbons. Techikoleff's early lamp was of this type.

Carbons controlled by a motor running at a certain speed when the arc is of normal length and varying in speed when the arc is too short or too long, combined with a centrifugal governor on the shaft of the motor, acting on variations of speed to gear motor shaft, to screw carbons together or apart as needed to maintain the normal arc. This mechanism has been applied by me to large arc lamps, such as naval search lights and has the advantage of great positiveness and an ability to handle heavy mechanism.

There are also a considerable number of modifications from these principles stated which cannot be referred to here.

Another excellent mechanism and one of the most powerful and positive in feeding the carbons embodies a main magnet separating the carbons and striking the arc and an intermittently acting shunt magnet for working a pawl which by a suitable gearing forces the feeding action on approach of the carbons as required. I have used an endless screw gearing with the pawl acting on the ratchet wheel to turn the screw, the worm wheel being on a shaft carrying a pinion meshing into a rack on the carbon rod. The worm wheel gearing is lifted by the main magnet to strike the arc, and the shunt magnet in operating its pawl breaks its own circuit, and repeats its feeding action as often as may be necessary.

It is interesting to note in this connection that I have built such lamps in which each feeding movement of the carbon is not over one-five-thousandth of an inch and that if the upper carbon rod is held in a vise the mechanism will lift the whole lamp of about twenty pounds' weight in feeding, so positive is the action. At the same time the length of the arc is maintained constant at all times. With so slight and yet positive a feeding action the feed takes place almost continuously.

In the foregoing brief review many matters have been simply touched upon which might readily have been expanded into a single paper as long as the present one. Material enough now certainly exists and could be collected for making a good technical work dealing with the science and practice of arc lighting. My purpose will have been fulfilled if I have succeeded in the present paper in adding some things of interest and instruction concerning this general subject from the standpoint of one who has constructed very many forms of apparatus for arc work and who has had a continuous and growing experience with such work from its beginnings up to the present great commercial expansion.

The Discussion.

M. M. Garver of Newark: I have listened with a great deal of pleasure to the able paper by Prof. Thomson and especially in regard to the view that the arc is constituted of incandescent carbon vapor. It may be of interest in this association to know that we have from purely theoretical means a clue to the temperature of the carbon vapor. We have no direct means of measuring it. About ten years ago in studying the subject of the generation of water gas I came across a clue of this character. There are two compounds of carbon in the form of a gas containing different amounts of carbon. In one the carbon is totally consumed. In the other it is partially consumed. By taking account of the different heating capacities of the two gases and divided by the specific gravity of the gas, we find that about ten or twelve thousand degrees Fahrenheit are necessary for the vaporization of carbon. This, of course, is assuming that the specific heat of carbon is the same at the higher temperature as at the lower, and takes no account of testing through the liquid state.

The Classification of Incandescent Lamps.

The President: The report of the committee on the proper lighting power of incandescent lamps is next in order. Dr. Louis Bell will present the report:

Dr. Bell: Your committee had not proceeded very far in the investigation of its topic before it discovered that the topic was growing—and growing with a prodigious rapidity, so that we have been able to formulate, so to speak, only a partial report, a report that necessarily must leave untouched many things we would have wished to cover, but which we hope embodies certain suggestions that may be of interest to those who have occasion to use incandescent lamps.

In the first place, the necessity for some legitimate rating of the candle power of incandescent lamps becomes evident in the experience of nearly every central station manager who is enterprising enough to keep track of the lamps he is using. At the last convention of this association your president gave some admirable samples of the way in which the candle power of alleged sixteen-candle power lamps varied anywhere from sixteen to eighteen. Now evidently it is both for the interest of the central station man and of the consumer that each should know exactly what is intended by a 16 candle power globe. It should not be left to the choice of the lamp manufacturer to make any sort of incandescent lamps he fancies and label it 16-candle power. There have been improvements in this direction, as every central station man knows.

Now, the questions that came up were about as follows: How should we classify the power of the incandescent lamp at all? Shall we classify it entirely by the candle power; or, if not the candle power, to what standard shall we refer the light? Shall we classify it by what is consumed, with specifications for efficiency or by the watts consumed according to the specifications, and the candle power which it gives within the limitation of efficiency? After a considerable amount of deliberation—aided, I am glad to say, by consultations with a large number of gentlemen who are practical experts on incandescent lamp matters—your committee came to the conclusion that the last mentioned method of classification was the simplest one to enforce, that is, incandescent lamps should be classified by the watts consumed, the actual power for which the consumer pays; but with the specification as to candle power that limits the efficiency of the lamp to practical values. By practical values I mean such as will not, on the one hand, produce an inordinate waste of energy, or, on the other hand, force a lamp far above its proper candle power and consequently burn it out. The interest of the lamp manufacturer evidently lies toward greater efficiency, because by producing a very efficient lamp, one which will give a large candle power on a small consumption of watts, he is enabled, in the first place, to give a fine, brilliant light, satisfy consumers, and, in the second place, to point with some pride to a reality of power. Unfortunately, when this tendency is carried beyond a certain point, as every practical man knows, the life of the lamp is enormously shortened. A lamp which will burn for 1,000 or 1,500 hours at a moderate efficiency, if forced to a very high efficiency, will burn a very much shorter time. Now, having determined the proper way, in general, of classifying incandescent lamps, there arose the all-important question of the proper limits to be set. We have been so long used to speaking of and dealing in 16 candle power lamps that it seemed inadvisable to abandon that standard. Given, then, the proposition that we are to have a 16-candle power lamp—a candle power that has been sanctioned by very long use—what do we mean by that 16-candle power? Do we mean that the lamp shall give 16-candle power in a determined direction? Sixteen-candle power means horizontal illumination, or what? Inasmuch as the horizontal luminosity is that with which we have to do in these cases, your committee was emphatically of the opinion that the mean horizontal candle power should be specified in other words, that the normal 16-candle power limit should give 16-candle power, taking the average of the horizontal illumination

Next came the question of practical limits within which the candle power might be allowed to vary. Of course, if we tied ourselves down to a candle power of mean horizontal intensity, we will be establishing a standard which no lamp manufacturer could approach. In other words, it would become really impracticable to make a large number of lamps at a low price and have the candle power of each one exactly the same.

Taking the lamps as they are we find in actual practice, we have to set those limits possibly, seven or eight, possibly six, on each side of the 16 candle power. Those limits your committee found to be entirely too wide, and therefore it entered into consultation with lamp makers for the purpose of finding how close to 16-candle power the limits could be set and yet leave the manufacturer a simple and practical process. The result of this deliberation was to settle upon about one-candle power on either side of sixteen as, on the one hand, the largest variation which we cared to admit in defining a normal lamp, and, on the other hand, being a variation which comes easily within the lines of commercial manufacture.

These two points determined, next came the unfortunate question of efficiency, the possible efficiency of incandescent lamps. Given a reasonably long life there are as many opinions as there are makers of lamps, besides a very few stray opinions advanced by theorists, and still fewer advanced by practical men. A large amount of consultation was had on this topic. Some of the experts in lamp matters advocate the use systematically of lamps giving the candle power on not less than four volts. Others loudly proclaim that three or two and one-half volts is quite a practical and reasonable figure. In this regard I shall have to appeal to the central station manager. Your committee was necessarily at sea to a certain extent in determining this particular point; but after a large amount of consultation, both with central station men, and with lamp manufacturers and experts, it would suggest that for the average central station to use, taking into account the fact that sometimes we are supplying lamps by contract, and sometimes by meter, an efficiency of less than four watts per candle is undesirable, particularly if the electricity is furnished by meter. When the consumer has to pay for more than four watts per candle power he becomes inclined to object seriously to the bills.

Then, as to the inferior limit of efficiency. On how small a number of volts is it possible to produce the candle power and at the same time have a lamp of reasonably long life, and giving a reasonably uniform efficiency throughout its light? The very best commercial practice seems to set the figure a little over three watts. Without specifying then, the efficiency for normal standard lamp, your committee would suggest that a lamp giving over fifteen, and not over seventeen, mean horizontal candle power on a consumption of less than sixty, and not less than fifty-five watts, represents the average conditions of central station practice, perhaps better than any limit that could readily be found.

I am quite aware that in stating this fifty-five watt limit your committee is running in the face of opinions which are entitled to some credit, but I would call the attention of any one who objects to that limit to the fact that with this normal standard lamp, as thus defined, if a lamp can be produced giving the candle power with good life on a little over three watts it still falls within the standard. The effect in that case would simply be this: that the manufacturer who could produce a lamp giving the candle power well and steadily on a little over three watts would furnish as the standard lamp a lamp which would come very near to the 17-candle power limit. In other words, he would get the credit for having a little brighter lamp than some of his contemporaries, and so would not in any way suffer by the establishment of that standard.

This suggestion for a normal standard incandescent lamp is the best that your committee is able as yet to bring forward, and we trust that it will fall reasonably near the limits that most of the members of the association have found in their actual practice.

Now, as to determining the mean horizontal candle power on which our standard lamp should be based, several difficulties were encountered in the beginning of this work. In the first place the distribution of light that is given by an incandescent lamp is not altogether uniform. In lamps with twisted filaments the distribution is very uniform; in lamps of straight filaments, of round section, fairly uniform; in lamps of straight filaments of square, or nearly square, section, it was something like that (indicating on diagram) showing the maximum at 45° from the plane of filament. When filaments of rectangular section are employed with a considerable difference of the length of the sides of the rectangle, the distribution may become almost anything varying in the most erratic fashion, as you may see on this diagram.

Now, for all lamps giving a uniform distribution, a single reading on the photometer is enough to determine the candle power. In almost all of the twisted filament lamps a single reading will determine the mean horizontal candle power closely enough for all practical purposes. When a lamp of this description is reached a single reading might or might not be fair to the lamp. If the reading

were taken at this point (indicating on diagram) it would be altogether too fair to the lamp because a lamp which would give 16-candle power, 45° off the filament would give nothing like 16-candle power mean horizontal intensity; in other words, it would be measured at the maximum point. Contrawise measuring off the face of the filament would be very unfair to the lamp. In lamps of this general construction—and there are more than one make of them on the market—in reading off the edge of the filament it will give in nearly every case a very close approximation to the average horizontal power. If one has a regular photometer at hand three readings at 120° apart taken anywhere on the lamps that they happen to have, will give an approximation, which in every case is correct within one per cent.

Now, taking a worse case of distribution (here another diagram was shown), you see the difficulties are even greater. Here the irregular circle is the actual distribution of the light; the outer circle is the mean horizontal intensity, and the inner circle is the alleged candle power of the lamp. I may state in passing that this particular make of lamp is now no longer manufactured, so that I won't be treading on the toes of anybody present. In that case no reasonable accommodation readings would give the mean horizontal intensity. For all practical lamps—in fact, for nearly all of them now used—one reading will give a very close approximation taken anywhere in the case of the twisted filament lamp. Taken either with filament edge, on or about 30° off that point, in the case of lamps having a squarish distribution, and in lamps of more irregular character, it is only fair to say that one reading is not enough.

There is one way, however, of determining the mean horizontal candle power, and that is by spinning the lamp about an axis as it is being tested. If the lamp be mounted in a socket, and spun rapidly about its own axis the mean horizontal candle power would be obtained at once if the velocity of spinning rises above a certain point—above 300 or 400 turns a minute. This has been tried several times with more or less success. It is tried in at least one lamp factory with uniform and unvarying success, and it is certainly worth trying in case we have to deal with very irregular lamps.

Now, appreciating the fact that the average central station man has not an elaborate photometer, and usually has no man whom he can train up to do accurate photometer work, your committee suggest the use of a lamp tester; its purpose being to see whether the lamp falls within the standard limits as just defined. For that purpose a cheap and simple apparatus is all that is necessary. Take a board about seven feet long. At about its middle point saw half way through the board, and stick in the saw cut a piece of tin painted black, about eight inches square, or of any convenient size in fact, with a two-inch circular hole cut through it. Over that hole put the photomoter disc, merely a piece of thin paper, with an oil spot. Just 36 inches from that photometer disc place a lamp socket, which can be twisted around its axis, fitting through the hole to carry the socket of the lamp which is to be tested. At the other end of the board cut a slot, and on a little slide set a lamp socket for a standard lamp. Make the slot of such a length that when the slide that carries the lamp is pushed up to its nearest point to the screen it shall be distant from it 34 and 15-16 inches. Make the other end of the slot far enough over so that when the lamp is pushed to that extreme end it shall be distant from the screen 37 3-16 inches. The latter situation will correspond to the 15-candle power lamp to be tested; the former position to the 17 candle power lamp to be tested. As regards standard lamps, if you are fortunate enough to be near a laboratory it is not a difficult matter to get a 16-candle power lamp of the voltage you use, giving preferred 16 candle power right off the plane of the filament. I wrote personally to Dr. Duncan of the Johns Hopkins University, asking whether they could furnish standard lamps from their testing bureau. I regret to say that I have not yet heard from them, but doubtless their testing bureau will be able to furnish lamps which should give directly off the plane of the filament 16-candle power. These would serve as standard. With that apparatus fitted with measuring instruments lamp testing can be carried on with great rapidity. The lamp to be tested and the standard lamp should both be on the same circuit in parallel; consequently, exposed to the same voltage. The rheostat in the series is prepared so that the voltage can be brought to the point intended. Measuring instruments of any kind that you have at hand will give the consumption in watts. If the lamp to be tested is within the standard limits—that is to say, is under 17-candle power, when the standard lamp is pulled to the nearer end of the slot, the oil spot on the photometer disc will appear bright and lighter than the surrounding paper. Pushing the standard lamp to the further end of the slot it should appear dark, if the lamp being tested is within the normal standard. Thus, no setting is required. There are two positive things to be seen, one at each end of the slot. The photometer side should appear bright at one end and dark at the other, if the lamp is of the proper candle power. This avoids the difficulties of exact settings, and I think in most cases will eliminate the personal error that is sometimes very vexatious.

It was felt by your committee that some such device was necessary in order to prevent the careless photometer work on the part of the linemen and station man to whom the thing might be intrusted. It is very rarely that the manager of a station himself has the time or cares to go to the trouble of going through this testing himself, and it is not always practical to secure a thoroughly competent man to do it. So the intention of the committee was to devise a lamp tester which should define the maximum and minimum range allowed without requiring an exact setting.

PRESIDENT OF COMMITTEE ON LEGISLATION.

[illegible] The next business will be a report from the committee on legislation, and Judge Armstrong will make the report.

[illegible] I will state that it was the idea at the outset to have a representative on the committee from each state in the Union, to receive at the headquarters of the convention, the secretary's office, a report of all matters of legislation pending in the various state legislatures. Very few, if any, of these reports have been received, so that I presume it is safe to apprehend that very little legislation outside of the ordinary course has been, or is being attempted. The most of the state legislatures being now in session of course the report cannot be and is not as full as we should be able to have it at a summer convention. In our own state, New Jersey, the regular line of bills to bury all wires underground, to put them 100 feet above the ground, and to carry them along in various ways, have been introduced.

I have a report here from George C. Maynard, from the District of Columbia, in which he says:

SPECIAL CENSUS LEGISLATION.

The report of the National Committee on Legislation, by George C Maynard, follows:

It has been my special duty to look after the Senate bill No. 4329, introduced by Senator Hale on the 15th of August, 1890, and referred to the committee on census. A copy of memorials adopted at the twelfth convention, was mailed to all members of the association and to boards of trade and commercial bodies, from the office of the secretary in New York. In addition to these, 500 copies were mailed from Washington to various other persons and corporations.

Resolutions strongly urging the passage of the bill, adopted by the following named organizations, have been presented to the Senate and referred to the census committee: National Board of Trade and Transportation, New York; Indianapolis Board of Trade, Indianapolis, Ind.; Master Builders' Exchange, Philadelphia Pa.; Chamber of Commerce, New Haven, Conn.; Merchants' Exchange, St. Louis, Mo.; Retail Grocers' association, Lincoln, Neb.; Commercial Club, Kansas City, Mo.; Association of Edison Illuminating companies; Board of Trade, Omaha, Neb; Wilkes-Barre Board of Trade, Wilkes-Barre, Pa.

In response to the memorials sent from Washington answers were received from a considerable number o prominent companies and individuals stating that specia personal appeals had been made to senators and representatives, asking their support of the bill. Accompanying these replies were copies of letters from many senators promising their cordial support of the measure whenever it should come up. These communications were from: The Standard Underground Cable company, Pittsburg, Pa.; The Utica Electric Light company; Citizens' Illuminating company, Brooklyn, N. Y.; Wheeling Electrical company, Wheeling, W. Va.; the Simplex Electrical company, Boston, Mass.; J. J. Burleigh, Camden, N. J.; Wm. B. Wilson, Philadelphia Pa.: F. B. Knight Austin, Tex.; Geo N Stone, Cincinnati, Ohio; M. B. Leonard, Richmond, Va.; H. B. Chamberlin, Denver, Colo.; Geo. M. Dugan, Jackson, Tenn.; Noah H. Cheever, Ann Arbor, Mich.

In addition to this work a great deal has been done by members of the association and others by private letters to, or personal interviews with senators or representatives.

So far as learned, not a single congressman has made any objection to it, and nothing but the extraordinary pressure of important business has prevented its passage. It may reasonably be expected that the bill will pass at this or the next congress.

The Illinois Electric Lighting association has issued a circular referring to legislation in that state, which is now engaging their attention. The letter says:

"An effort will be made at the present session of the state legislature to pass a bill authorizing cities and towns in Illinois to operate electric lighting and power plants for the purpose of commercial, as well as municipal lighting.

"The injury to our mutual interests which would result from any such legislation is too apparent to call for special comment. One and all of us who have investments in electrical central stations are deeply concerned in the defeat of any measure which so palpably aims at our very existence. The urgency of the situation demands immediate and united action on the part of all concerned in electrical distribution. The passage of such a bill means the practical destruction of our capital, and if any efforts on our part can avail to thwart this movement, now is the time to put them forth for the sake of preservation.

"If each one of us will use the influence he may be possessed of with the local representatives to the legislature, and if each company will lay the facts before the board of directors and induce them to bring the weight of their arguments to bear upon our legislators, it is possible that the designs of the demagogues may be frustrated.

"The Illinois Electric Lighting association was organized with a view to just such an emergency as this. The responses to the calls which were sent out at its inception were very few in number, probably because at that time the central stations throughout the state did not appreciate how soon they might be called upon to act in concert. Small as the association is, however, it proposes to do all that it can, but it is evident that its work would be much more effective if it were more representative of all the central stations in the state, and it is suggested for your consideration that you take the matter of joining the association once more under advisement. In the meanwhile it is imperative that the personal efforts of everybody interested be exerted toward the defeat of the proposed action of the legislature."

I suppose that Massachusetts has had the most uncomfortable experience lately of any of the states. Everett W. Burdett, who is the attorney of the Massachusetts Electrical association of Boston, is here to day, and he will make a report upon matters in the Massachusetts legislature. Mr. Francisco from Rutland, will, I believe, make a report of what has been done in Vermont. Now, if we can get to the secretary all of the bills and measures that are pending before the several state legislatures, and a statement of what has been done concerning each of these things, it will make in time a very valuable library upon this one point. I have thought that possibly electricity, having annihilated both time and space, ought to have no past and ought to have no future but be a continuous present. We must protect ourselves—not from intentionally wrong legislation, but from the result of ignorance.

EVERETT W. BURDETT of Boston: In Massachusetts we have now and have had more attempted legislation to the square inch than any other community, large or small, within the boundaries of the United States. Our experience has been not as yet painful, because nothing has been accomplished of any account upon the other side, but it has certainly been interesting, and I think it will be instructive to those representing these interests in our states. I may say that last year and this we have had printed a copy of every order or suggested law which is pending, or has been pending, before our legislature, and that has been sent to about five hundred persons in the state directly interested in the industry, and in that way we have spread throughout the length and breadth of Massachusetts accurate information as to what was on foot and followed it up, as I did yesterday, for the year 1891, with brief statements of reasons which should be given adverse to the proposed legislation.

The matters affecting electric lighting interests which were before the Massachusetts legislature of 1890, are reported in the proceedings of the last convention of this association. They consisted of sixteen orders and numerous petitions, upon all of which action was had by committees of the legislature. The only law which resulted from this agitation was chapter 404 of the acts of 1890, relating to the regulation and supervision of wires over streets or buildings in cities. This act requires strong and suitable insulation of all wires at points of attachment, strong and suitable supports, the removal of all abandoned wires, appliances calculated to prevent currents of electricity capable of injuring electrical instruments or causing fire from entering buildings, and the tagging or marking of each wire or cable so as to designate the owner or user thereof. It further provides for the appointment of an officer to supervise all wires in cities, to remove abandoned wires, and generally to have the supervision of the use of wires

There is pending before the present legislature a proposition to extend this act to the towns as well as the cities of the commonwealth, and to enlarge its provisions in its application to the city of Boston.

The agitation in favor of the enactment of a law to permit municipalities to own and operate gas and electric light plants, resulting in a bill which was passed to be engrossed by the house, was referred by the senate to the legislature of 1891. This bill is now pending before the present joint committee on manufactures. While this bill was pending in 1890, the house of representatives required the opinion of justices of the supreme judicial court upon the questions whether it was within the constitutional power of the legislature to enact a law conferring upon cities and towns the power to manufacture electric light for use in the public streets and buildings of such cities and towns, and for the purpose of selling the same to their citizens.

Both questions were answered in the affirmative. The decision mainly turned upon the question whether the manufacture and distribution of gas and electricity by cities and towns for illuminating purposes were a public service within the meaning of the constitution (part II, Chap. 1, Sec. 4). The court held that the maintenance of public streets and buildings is a public service; that they may be lighted at the public's expense. That the means of lighting are a matter of expedience; and that the legislature may authorize this to be done by any appropriate means which it may think expedient. As a question of constitutional power, the right to authorize cities and towns to buy gas and electricity for their use, cannot, in the opinion of the court, be distinguished from the right to authorize them to manufacture it for their use. The first question was therefore answered in the affirmative.

The second question involved more complications owing to the difficulty of defining with entire accuracy all the characteristics which distinguish a public service and a public use from service and uses which are private, but the same conclusion was reached.

The court did not consider whether the furnishing of gas and electricity for supplying heat and power can be regarded as a public service, and expressly they did not pass upon that question.

This opinion of the justices having been received, the bill was taken up by the house and passed, though in a somewhat different form from that submitted to the court. It permits any of the cities or towns of Massachusetts not only to establish plants by purchase or otherwise, for municipal purposes, but to supply light, heat and power by means of gas or electricity, to any of their inhabitants. It also permits any city or town thus establishing a plant to supply gas or electricity, for any or all of the purposes named to adjoining cities and towns and to the inhabitants thereof. It contains no provision requiring the purchase by cities or towns establishing municipal plants, of plants already existing in such places, and permits the purchase of only that portion of existing plants that consist of "real estate or is attached to real estate so that it cannot be removed and rendered available elsewhere without material loss, injury or expense."

In case of companies supplying both gas and electricity the bill permits to purchase of one or the other branch of the business as the town or city may elect. Notwithstanding the failure of this bill to become a law the town of Peabody voted to establish a town plant for lighting its public street and and incidentally to utilize its surplus power and apparatus in supplying private consumers. A bill in equity was brought to restrain the town from carrying this vote into effect. The case has been decided by the full bench of the Supreme Judicial Court, and will be recorded under the name of Spaulding vs. Peabody in Vol. 20, 151 Mass. Reports.

In deciding this case, the court said that the authority

claimed for the town is not within any of the customary powers which towns from very early times have exercised, and must be derived if it exists from the statutes relating to towns. The authority was claimed under the provisions of a statute which employs language first used in an act of 1692, that a town may grant "money for all other necessary charges arising in such town," and from the authority of towns to erect and maintain street lamps. But the court pointed out that the phrase "all other necessary charges" has been given a very limited scope, and that special enabling provisions have been deemed necessary whenever extensions of the rights of town expenditure have been sought. As to the claim that the power was incident to that of erecting and maintaining street lamps, the court said: "The subject of construction and maintaining gas or electric works for the manufacture of gas or electricity, and the distribution of them through the streets of towns and cities for the purpose of furnishing light, is one of too much importance to be attached as a mere incident to the power given to erect and maintain street lamps, and we think that if the legislature had intended that towns generally should have authority to erect and maintain such works, the authority would have been plainly expressed in statutes, with such limitation and accompanied by such restrictions as the legislature might think it prudent to establish. We see no indication in the existing statutes that the legislature intended to make provision for the exercise of such authority by the towns of the commonwealth."

In order to leave no doubt upon the question whether towns and cities can, under existing laws, establish and maintain plants for municipal purposes only, the opinion concluded as follows: "If we assume that the only action now contemplated by the town of Peabody is the erection and maintenance of electrical works for the purpose of lighting its streets, still we are of the opinion that the vote it beyond the legal rights and power of the town. P. S. Ch. 28, Sec., 129."

This decision upon the existing state of the law in Massachusetts, as well as the opinion of the justices upon the constitutional questions involved, are stated with some particularity, owing alike to the importance of the questions and the eminent authority of the court which has passed upon them. While both opinions rest largely upon the particular language employed, in the one case in our constitution, and in the other case, in our laws governing towns, they involve the consideration of such important general principle that they are worthy of study in any jurisdiction.

In connection with the bill for municipal ownership the committee on manufacture has before it the recommendation of the governor that the powers of municipal corporations be enlarged by general law in the matter of "municipal control of municipal work and ownership of the instrumentalities for its performance," which it will be observed does not go to the extent of recommending the enlargement of the powers of towns and cities so as to enable them to manufacture and supply gas or electricity for commercial purposes. The governor is on record against an extension of the law in the latter directions. In addition to the bill above referred to and the recommendation of the governor, there are orders covering the same subject matter and numerous petitions in aid thereof, including a petition of the common council of the city of Boston. The extent to which some of the petitions go is shown by the fact that in one case the passage of a law is prayed for to enable cities and towns to engage in all lawful business that the citizens of such cities and towns may desire to enter into. Another one prays for a state loan of $3,000,000 to cities and towns, to enable them to build for the people, similar to state loans to railroad corporations. Separate petitions have been filed by the towns of Danvers, Peabody and Hudson, and the towns of Brookline and Melrose have voted to appear in favor of the general legislation.

The hearings upon this subject are now in progress. Before the same committee there are pending bills to provide for state inspection of electric lights and meters, for the abolition of the Board of Gas & Electric Light commissioners and the appointment of a Board of Gas & Electric Light control in its stead; and for the consolidation of gas and electric light companies situated in the same city or town, with a capitalization equal to their appraised valuations. Before the committee on mercantile affairs the following orders are pending:

For the extension of the provisions of Chapter 404 of the Acts of 1890 to the towns of the commonwealth, and the enlargement of the same in their application to the city of Boston; for the better regulation and control by state, city and town officers of the acts and business of persons, associations or corporations making use, for business purposes, of wires over or under the public highways, and regulating by law the incorporation of companies for such purposes, and all proceedings and work to extend such wires over or under the public highways; for the better protection of persons and property against injury from electric wires; for further legislation to granting locations for poles to companies in towns, and authorizing the selectmen of towns and the aldermen of cities to relocate and remove, at their discretion, the poles of electrical companies from the streets and highways, notwithstanding any prior grants or permits to erect and maintain the same, and also to compel the joint use of poles by different corporations.

Before the committees on cities and taxation are pending several orders as to authorizing cities and towns to prescribe terms and conditions, and to impose taxes, for the use of their streets by private corporations; as to the expediency of abolishing the state corporation tax on corporations exercising municipal privileges, and so taxing such corporations that the towns and cities in which such municipal privileges are exercised shall receive the entire tax, and other orders of a similar nature. There is also an important order pending before the committee on cities as to the expediency of authorizing the city of Boston to make contracts, for twenty years or less, for lighting its streets, public places and parks, and to grant exclusive rights for the use of its streets as a consideration for such contracts.

The foregoing statement includes in outlines all matter of legislation and adjudication with one exception touching electric lighting interests which have arisen in Massachusetts since the last report.

The exception referred to is the decision of the Supreme Court in the case of Suburban Light & Power company vs the Aldermen of the City of Boston, reported in Vol 150 Mass. Reps. In this case it is decided that the granting of pole locations to electric light companies is not mandatory under our statutes (P. S. Ch. 109, Sections 2 and 3), upon aldermen or selectmen, but rests entirely within the discretion of those officials.

MR. FRANCISCO: Speaking for the state of Vermont, I would say that we have not had very much trouble. The only case we have had in my own town, Rutland, was about a year ago, in regard to municipal ownership. The alder men conceived the idea that they could furnish electric lights without any expense to the citizens. They became convinced that that could be carried out through the influence of outside parties, and the wonderful stories told by different people; but by concerted action we had the matter referred to the popular vote, letting the masses vote upon the subject, as they did in the regular election, and the result was that the vote cast was 10 to 1 in opposition to municipal ownership, which eventually ended all strife on that question in that town, for all time to come, I think. In the legislature we had a bill introduced allowing one company to occupy the poles of another company, and that bill was killed in the committee room. We also had a bill introduced, which became a law, compelling all companies to remove all crooked poles, or poles that were not first-class in every respect, and replace them with new, straight and perfect poles, and paint all poles within the city limits. We had a bill introduced at the last session requiring all electric light companies to run the lines entirely distinct from and in such a manner as not to interfere with the business or the wires or occupation of the telephone companies. That bill died a natural death in the committee room. There was also a bill introduced at the same time requiring telephone companies to comply with the same law and not run anything but metallic circuits with proper insulation. When that came up the telephone companies were anxious to have it die, and that died also in committee room.

That is the only legislation we have had in our state since our last meeting.

GEORGE R. STETZEL of New Bedford: I should like to inquire if there has ever been a case where an electric light company had asserted any right to any property in the street in the use and transaction of their business? I represent a company in the State of Massachusetts, and, as I understand it and as we act, we are very much in the position of the popular interpretation of the Dred-Scott decision: We have no rights that the white man is bound to respect. The city does as it sees fit in every instance, and we have no method of redress. Out of perhaps eight hundred poles there are from eighty to one hundred that are used for any purpose that the municipality may see fit to put them to. Within the past three months the city has been establishing a police signal system; they have put their boxes on our poles, sawing some of the poles two inches needlessly, and it looks to me maliciously, that they may have a base for the box to rest on the pole. They have not only done that, but they have taken the wires from the top of the poles down through the boxes through an iron gas pipe and from that box they go directly into the ground. My linemen say it will be a difficult thing to sit on the top of that pole in damp weather. Now, I consider this a menace to the life and limb of my workmen, and it is something that money should not and could not have bought from us. I never should have consented to any condition that should multiply the opportunities for accidents, because such accidents are so serious in their consequence to our industry. As regards the conditions in Massachusetts, it seems to me that we are simply the objects to be fought, without regard to our rights. Before the committee, which has a meeting to-morrow, and which I shall leave here to attend, the broad ground is taken that we have no rights, and that is the nature of the legislation which will be established in Massachusetts without doubt.

J. J. BURLEIGH: May I interrupt the gentleman for just one moment? Prof. Thomson's paper was so able and interesting and so very instructive that I want to move a vote of thanks to Prof. Thomson for his trouble and pains and to express our pleasure.

The motion was seconded from various parts of the house and unanimously carried.

MR. DE CAMP: I would say that in the state of Pennsylvania the municipal authorities recognize the rights of the companies to their poles when they have once become established. I don't know that a company has ever been interfered with. The city of Philadelphia makes a respectable application to us for the right to use our poles, as we do to them for the right to use theirs. Some five years ago when the question of the removal of poles was up before the legislature, the very eminent counsel who argued the case there took the position, and it did not seem to be questioned, that in case such a law was passed the companies would be entitled to compensation.

THE PRESIDENT: If there be no further discussion, the convention will adjourn until Thursday morning at 10 o'clock.

Thursday's Proceedings.

The convention was called to order at 10:20 A. M.

THE PRESIDENT: The first thing on the calendar this morning is a paper on the Ferranti system by C. D. Haskins.

MR. HASKINS: I want to say in the first place that my paper is a sort of adjunct to photographs that I have of some Ferranti machinery. If I did not have the photographs I do not think I should have been willing to undertake the paper, because the photographs are what are going to be interesting.

Mr. Haskins then read the following paper

THE FERRANTI SYSTEM.

BY CARYL D. HASKINS.

I keenly appreciate the compliment which your committee has paid me, in naming me to appear before you to-day to read a paper.

I fully realize that much is expected of me, and I believe I even more fully realize my inability to handle the subject with the completeness which I could wish.

My connection with Mr Ferranti was not of long duration, and it is now some time since I severed my connection with him, so that my information while pretty complete so far as it goes, is not as thoroughly up to date as it should be.

The Deptford station was far from finished when I left London, and 10,000 volts generated direct from the dynamo was still a matter for surmise and conjecture.

Under these circumstances the best thing I can do, I believe, will be to keep up each feature of the system separately, and describe it to you in its various forms and applications as thoroughly as I can. Starting with this plan in view, I have arranged my paper under the following heads:

Methods of Distribution.
Ferranti Dynamos.
Ferranti Transformers, Fuses, etc.
The Ferranti Meter.

Starting, then, with Mr. Ferranti's methods of distribution, I will deal first with the old and somewhat famous Grosvenor Gallery station, from which current at a pressure of 2 500 volts, was distributed throughout the most wealthy portion of London's West End, by means of overhead wires.

At the Grosvenor station there were two dynamos, each of 625 horse-power nominal. These machines I will describe later on.

From these generators the circuit was carried to five double-pole, double throw switches, each having a break of two feet and breaking both sides of the line at once.

Each of these switches represented a circuit, there being five circuits in all run from the Grosvenor station. It will readily be seen, therefore, that the switch-board of this station, which distributed light to no less than 35,000 lamps, was an exceedingly simple affair, yet, with their five switches, any desired combination of machines and circuits could be made.

It has quite frequently been stated, I believe, that these two machines at the Grosvenor were run in multiple. This is in no sense true, though since the removal of these dynamos to Deptford station, they are to be connected in this manner, I understand.

From the five main switches the current was carried through Ferranti plug fuses of rather peculiar construction, having a break of two feet. These fuses I shall describe later. From the fuses the circuits were carried on ordinary wiring to an overhead distributing pole. From this center the wires branched in five directions, being carried over the house-tops and not through the streets, as is our custom in America.

Stranded steel cables 7-16 B. W. G. are stretched from pole to pole, and from these cables the mains are supported at frequent intervals by means of leather thongs or slings, thus saving undue chafing and straining of the conductors. This method of supporting the main presents many marked advantages; the wear of insulation is reduced to a minimum, and the liability to a ground is very much diminished. The leather slings stand the wear and weather exceedingly well, and renewals are much less frequent than would be expected, especially if one take one's foot wear as a basis for calculation.

All streets are crossed at right angles, and no difficulty is experienced with the ubiquitous telephone man.

Contrary to the custom in this country, the primary wires are generally run into the house to be lighted, where they are connected to the transformer, a Ferranti fuse being placed in the circuit.

The secondary circuits are of 50 or 100 volts pressure, as may be required, and the house wiring is quite of the usual style, having a principal secondary fuse at the transformer, and a Ferranti recording meter in series with the lamps.

The Grosvenor Gallery as a generating station is now a thing of the past. It has been reconstructed, and is now one of the four transforming centers of the Deptford system, which draw their energy at the phenomenal pressure of 10,000 volts from the machines in the great station on the Thames.

This heavy pressure is reduced at these central points by means of large transformers, and is distributed over the London house tops at an e. m. f. of 2,500 volts in the manner I have already described, the only difference here being that these overhead mains are on a secondary instead of a primary circuit and the house circuits become tertiary instead of secondary.

The portion of the Ferranti system of distribution which has given rise to the most interest and which has been most talked of, is the present primary circuit, extending from Deptford to the four central distributing stations in London.

Many curious and wonderful letters regarding this have appeared in our journals at various times, and have given rise to much confusion and many wild conjectures, whilst the real facts of the matter are, I believe, but little understood.

The shape and principle of Mr. Ferranti's concentric main is familiar to all, but a few words descriptive of it may not be out of place here.

Over a copper tube, about 1½ inches in diameter, insulation is wound in the form of a stout manilla paper, thoroughly saturated with a special insulating compound. This insulation is wound on to a thickness of one-half inch by a machine specially designed for the purpose by Mr. Ferranti; over this insulation a second copper tube is placed, of the same sectional area as the inner one, and this is drawn down till tight.

The cable is made in lengths of twenty feet and stands static tests of immense pressure. Special plug and expan

sion joints are provided for connecting the lengths, which are also thoroughly reliable.

The original intention was to lay these mains with the outer tube directly to earth throughout its entire length, thus rendering the system absolutely safe, since only one side of the circuit could be touched by the hand, and there would be no difference of potential between this and the ground.

Alternating circuits, and grounded telephone lines do not agree, however, and the law demanded that the Ferranti mains be laid duly insulated from earth; this is therefore done, but one terminal of the machine is still connected to ground, and comparative safety is the result, since it will readily be seen that to short-circuit through the body, it would still be necessary to touch the inner tube of the conductor. This would necessitate cutting through the outer tube and insulation, which would mean a short circuit from tube to tube, through the cutting instrument, a dead short circuit on the machine certainly, but perfectly safe for the meddler.

At the collector boxes of the machine an accident is impossible, since the collectors are inclosed within an iron box, the lid of which is magnetically locked by the exciting current—nor can the machine generate when the box is open, since the exciting circuit is not complete till the box is closed.

Unfortunately time was an object in the starting of the Deptford station, and much contract made cable was laid; the greater part of this was the lead-covered cable so frequently mentioned; this was not of the concentric pattern, but an ordinary stranded cable—I understand that it was guaranteed to stand considerably above 10,000 volts, but after being laid it was found not to stand 10,000 at all, and to give but poor satisfaction, even at 5,000.

This unfortunate trouble has given rise to much talk, and has been scarcely well understood by the general public.

Several other kinds of cable were tried, but gave equally unsatisfactory results, and all mains have doubtless by this time been replaced by the Ferranti concentric cable, which stands the pressure perfectly, and gives most satisfactory results.

Of the various expedients to which Mr. Ferranti had recourse during this trouble with the cables, I am not prepared to speak, first because I am not fully informed regarding them, and second, because they form no portion of the Ferranti system of distribution. They were simply makeshifts, necessitated by an unfortunate happening and by lack of time, and they have probably given rise to more discussion, both in and out of the papers, than has the system itself.

I will now pass on to a description of some typical Ferranti dynamos. First among these a few words are due to the original form of Ferranti alternator, which, while it is no longer manufactured, still, without doubt, was a machine of marked efficiency and great originality.

The characteristics of this earliest dynamo are, I think, about as follows: The figures are not based upon my personal experience, for the machine was out of date long before my time, but upon various fragmentary notes from my pocketbook, and a generous quotation from Thomson's "Dynamo Electric Machinery."

As in the Siemens machine of similar type, the fields formed, as they do now, "two upright circular crowns of electro-magnets with opposing poles." There were 16 magnets on each side, 32 in all.

The peculiarity of the machine lay in the armature, which consisted of a series of zigzag loops, eight in number, wound or folded one layer upon another, and separated by alternate ribbons of strip insulation of similar width. The winding was in three multiple circuits, each strip making ten turns around the zigzag coil, thirty layers of winding in all.

Each of these three coils is connected at one end with a solid star-shaped brass boss, which, bolted together from either side through the loops of the zigzag coil, forms a solid center for the disk armature, and at the same time connecting directly with one of the collector rings, the three coils all again uniting in an inner star-shaped piece of brass, which in its turn communicates with the second collector.

This disk armature was thirty inches in diameter, and one-half inch thick. Its extreme thickness permitted the magnet poles to be brought very close together, enough space only being allowed to insure safe clearance. The natural result of this was a very efficient field.

The dynamo was calculated for a speed of 1,400 revolutions per minute, and maintained a pressure of 100 volts. The armature weighed less than 100 pounds, and the entire machine rather less than 1½ tons.

Most of these old machines are still in use, principally upon British war ships, and are doing good service.

An excellent type of all the more modern Ferranti machines is the 150-horse power dynamo, which has been manufactured in considerable numbers; and is the alternator generally in use in most of the smaller stations using the Ferranti system.

In this machine the number of parts has been reduced to a minimum, and the efficiency is very high; it will fully illuminate 3,000 ten-candle power lamps, requiring an average energy of over thirty-five watts each.

The fields are arranged as in the old machines, and have twenty magnets on each side. The distance between the opposing faces of the fields is rather less than three-quarters of an inch, and within this narrow space the coils of the armature rotate at a speed of 400 revolutions per minute. The armature being four feet in diameter, this makes a peripheral speed of 4,800 feet per minute. The diameter of the armature shaft is 4½ inches, which at first sight seems rather large, since there is no great weight to carry, but the size is needed since the armature is overhung.

This armature is without iron, and consists of a central boss of gun-metal, into which are fixed ten carrying-arms of brass. These are insulated from, and held into the core by a special mixture of sulphur, which is poured in a liquid state and sets harder than metal itself

This sulphur insulator is one of Ferranti's specialties and prides, and much of the success of his machine is, I believe, due to it. I never, during my stay with him, met with a ground on an armature shaft.

Each of the ten carrying-arms which I have just mentioned, holds two coils or bobbins of copper tape tightly wound by machinery on a center made up of alternate strips of asbestos and brass. Terminating at one extremity is a gun-metal butt-piece, the entire coil being fastened to the carrying-arm by a single bolt passing through this butt-piece, and drawing the bobbin into place.

The winding of the bobbins themselves is of alternate layers of corrugated copper and fiber ribbon, the object of the corrugation being to prevent lateral slipping—a very necessary precaution.

The thickness of the bobbins, which form the only portion of the armature projecting between the fields is one-half inch, which leaves a margin of less than one-eighth inch clearance on each side.

The coils are connected in two parallel circuits, which are conducted away through the carrying-arms and the rods within the central boss itself, to the collector rings, where the current is taken off by Ferranti collectors—two half circular pieces of metal like the two halves of a severed ring, which almost surround the collector rings are held together by bronze springs, making an extremely good and constant contact, and not running at all hot.

The machine can be very quickly repaired; the two fields are divided at the center and slide back very readily, right and left, on extension bases, by the aid of a simple levering device. The armature is then exposed, hanging in its usual position, and it is but the work of a moment to take out and replace a burnt coil with a new one.

A few details regarding the two 625-horse power machines formerly used at the Grosvenor station, and now being installed with changed winding, to take the light day load at Deptford, may be of interest here, before I pass on to a description of the giant machines of the Deptford station. These two dynamos are in construction almost exactly like the 150-horse power type which I have already described. The machines were originally designed to give current for 10,000 ten candle power lamps each, but have frequently carried as high as 19,000 lamps without apparent effort. The weight of these dynamos is thirty five tons. The height from floor is nine feet six inches; the floor space required nine feet eleven inches; armature diameter, eight feet six inches; potential maintained, 2,500 volts; speed, 280 revolutions per minute.

There are forty coils or bobbins in the armature and forty field magnets on each side, eighty in all. The pulley is grooved for rope driving, Mr. Ferranti being fully convinced that this is infinitely better than the best belting.

It has probably been already remarked that I have made mention of no regulating device for the dynamos. Mr. Ferranti makes no provision for automatic governing, nor is it needed. It must be remembered that there is absolutely no iron in the armature, and that the machine is, therefore, self-regulating to a very large degree.

There is no compounding of the field, the field circuit being entirely simple and separate. At the Grosvenor the exciters used were Siemens machines, giving 108 amperes at 100 volts. At Deptford, Kapp machines coupled direct to Allen engines are used. These Kapp machines have rheostats in their field circuits, not for use in regulation, but in starting up and in case of emergency. It will be noticed that the two machines I have just described have not armatures arranged with the zigzag winding, adopted in the original Ferranti machine. This zigzag winding was abandoned for several reasons. It was impracticable for large armatures and a winding made up of separate bobbins or coils which could readily be removed and replaced was found to be exceedingly desirable. To meet these requirements, therefore, the method of winding was changed to an arrangement similar to what is generally spoken of in text-books as the "Siemens alternating armature."

It now remains to me, before passing on to the less important apparatus of the Ferranti system, to give a brief description of the two sizes of dynamo which are installed, and being installed at the Deptford station.

So much has been said and written about these during the past year or more, that I almost hesitate to mention them at all, so sure do I feel that almost every one here is familiar with their general character and dimensions.

The Deptford machines will be of two sizes, the portion of the station to be put into immediate use calling for three dynamos, two of 1,500 horse power each, and one of no less than 10,000. Of these the first two are now installed and running, whilst the 10,000 horse-power machine is still in course of construction, it being far too enormous a piece of machinery to admit of hurrying.

Each of the 1,500 horse-power machines are driven by means of 40 five-inch ropes from a compound vertical condensing engine of marine type, having a grooved drum or driving pulley.

The carrying-arms of the armature, which support the winding are fixed directly into one end of what may be called at once the pulley and the armature boss, by means of sulphur insulation. Into these carrying-arms are fixed the 48 bobbins which constitute the winding. The total diameter of the armature is 12 feet, 6 inches. The fields are arranged as in the smaller machines and have 48 magnets on each side, 96 in all. The copper strip composing the winding of the armature is three-quarters of an inch in width, and 1½ millimeters in thickness.

There is only one inch of space between the opposite magnet poles, and within this the armature rotates, having one-half inch clearance on each side.

Small fan-shaped ears are cast onto the carrying-arms of these, and the other machines which I have described, which, when the machines are in motion, force a constant current of air between armature and the field, keeping up a very perfect ventilation, and removing any dust which might accumulate upon the face of the magnets. This dust, if allowed to remain, would be apt to cause a short circuit from winding to magnets, as one pole of the machines is to ground; as an additional precaution against this the faces of the magnets are covered with a thin layer of vulcanite.

The frame divides as in the smaller machines, and slides back on extension bases to afford access to the armature, a special engine being provided to do this work.

Of the 10,000 horse-power dynamo, I can say but little; it will differ from the others only so far as its enormous size renders necessary. The armature will be no less than 40 feet in diameter, and will rotate at a speed of 60 revolutions per minute. It will be coupled direct to two compound vertical condensing engines, each of 5,000 horse-power, one on each side of the armature.

The shaft is the largest forging ever turned out of the celebrated Clyde work-shops, and one of the largest ever made in the world. It is no less than 36 inches in diameter, 28 inches in the bearings. I really do not dare state its weight. There will be 132 bobbins in the armature and 132 magnets on each side. The enormous size of this machine is quite beyond the comprehension of one who has not seen its parts.

The station instruments which are used in connection with the Ferranti dynamo, are the Sir William Thomson gravity direct reading ammeter, and the Sir William Thomson statical voltmeter.

I will now pass on to a brief description of the Ferranti transformer, meter, etc. I am aware that I have been able to give the merest outline of Ferranti's dynamo construction; the subject is far too intricate and wide a one to be treated at all in detail within the limits of a short paper.

Before describing the Ferranti transformer, I should say a few words about the Ferranti fuse. Its position seems naturally to be between dynamo and transformer. This is an exceedingly simple device of porcelain having a long break. It consists of two removable plugs, to which are fastened a number of thin strands of fuse wire, according to the current to be carried. These wires pass through a narrow crevice or slot in the earthenware, from plug to plug, the crevice being broken at short intervals by cup-shaped hollows, this construction preventing arcing. The fuse has a convenient earthenware cover, can be placed anywhere, and has always proved entirely trustworthy.

The Ferranti transformer is seemingly as little known as the dynamo in this country. It is a very simple affair, of decidedly high efficiency, consisting of a number of bundles of very thin, soft hoop iron, spaced apart with wedges, clamped tightly together and wound at their central portion with insulation. Each strip of iron is insulated from its neighbor for half its length, on each side, by paper pasted on. This, when the irons are turned back, as I shall presently describe, leaves a strip of paper between each layer of iron, but does not prevent a perfect magnetic circuit.

On these bundles of irons, at the portion wrapped with insulation, is wound the secondary, which is in its turn wrapped with insulation; on to all this the primary is slipped, in the shape of a number of coils, wound elsewhere on former blocks. These coils are slipped on, one by one, and separated from one another by washers of shellacked cardboard.

The projecting irons are then turned back over the coils from each end, lapping each other, first one way, then the other, like shuffled cards, and the last two are fastened off by a simple double "L" or tinsman's joint. Half of each bundle is turned back in each direction, up and down, forming complete magnetic circuits in two directions.

The transformer is extremely convenient in case of repairs, when the irons are readily straightened out, and burnt primary coils replaced.

It seems, however, to have several marked defects, the flat side of the lamination is presented to the penetration of the lines of force, which, according to Kennedy, is incorrect construction, and the transformer is inclined for this reason, both to heat rather badly, and to hum, the latter trouble being partly due doubtless to the fact that the iron cannot be held so firmly in this style of converter as in the more common type, where the iron forms a solid block.

The transformer is incased within a cast-iron shell, from which it is insulated, and into which the primary and secondary terminals are fixed by means of the Ferranti sulphur insulation.

These converters are made in five sizes, 25, 50, 100, 150 and 200 lighters. The large transformers for reducing the 10,000 volts of the primary to the 2,500 volts of the street circuits, are of the same construction as these I have just described. The insulation being of course, increased to bear the enormous pressure.

This is not the original transformer used by Ferranti; that was of the Gramme ring type, and rather more efficient than the present one, I believe, but scarcely practical from a mechanical standpoint.

There now remains to describe only the Ferranti meter, a most ingenious recording instrument largely used in connection with Mr. Ferranti's London circuits. This meter consists of a coil, of a few turns, in series with the lamps which passes around a core of soft iron, and terminates in a composition metal ring, which is split to prevent Foucault currents, and is bolted on to a soft iron base being, however, insulated from it. Thus it will be seen that the ring, the base, and the soft core around which the coil passes (the lower portion of which is burnt or cast into the ring also) form, respectively, sides, bottom and top of a hollow and tight trough; the iron is continued from above the coil, by means of a horseshoe shaped laminated piece of iron which passes down outside of the coil, and makes contact with the base; thus we have a magnetic pole at the top and bottom of the trough.

This trough is filled with mercury, making contact with three fourths of the inner circumference of the ring, and the center of the base. The current entering the coil, passes around it to the ring, and from the ring through the mercury to the base on which is the other terminal.

Under the combined influence of the magnetic field and the current passing through the mercury from center to periphery, and *vice versa*, the quicksilver is caused to rotate,

A shaft passes from a jewel in the base, through a small hole in the iron core to a train of wheels at the top; on this shaft is an aluminum fan suspended in the bath; this is all balanced so nicely that it actually floats in mercury.

Now, since the resistance to rotation due to friction is approximately proportional to the square of the speed, and the turning moment is proportional to the square of the current, the number of revolutions performed in a given time is a measure of the current which has passed through the meter during that period.

Owing, however, to the rule of friction not following this law absolutely, and owing to the additional and irregular friction of the gear, a sensible error is introduced. This difficulty is overcome by placing a shunt coil of high resistance around the series coil, which secures an excess of electro-magnetic action, when the friction is greatest in proportion to the torque, thus assisting the low loads.

The meter is very accurate, and has a quite wide range, 1 to 50 amperes being the capacity of the 100 volt instruments; it is equally serviceable on direct or alternating circuits of any frequency.

This meter, while undoubtedly accurate, has many very apparent weak points, however; the mercury volatilizes quite rapidly, especially when the instrument becomes warm; the meters must always be kept upright or their contents will spill, and they cannot be carried from place to place without being emptied and refilled, which, as the quantity of quicksilver varies, is apt to introduce errors. In view of these troubles, Ferranti is now also manufacturing and using a number of meters of small capacity, similar in principle to the well-known Shallenberger instrument, which are sufficiently accurate for general use; these are manufactured under the English patents of Mr. Wright, one of Mr. Ferranti's staff.

Discussion.

Mr. Law: I would like to ask Mr. Haskins some questions in regard to connecting transformers on to the primary circuit. We who have been in electrical lighting some time have been knocked down several times—last time in a pond of water ten inches deep filled with ice—do not like to receive those currents. Now to do successful commercial lighting we are obliged in order to compete with gas to keep a continuous service on our primary circuits. I would like to ask Mr. Haskins what provision they make for connecting converter wires on to the primary mains.

Mr. Haskins: Mr. Ferranti has, I believe, four or five methods. The commonest thing is a good deal like the brace that a plumber would put into a pipe. He brings out the inner tube through a sort of T joint and carries it a good distance before the insulation is removed from it. That gives him one leg of the circuit. The other is taken off by an outside ring which is soldered to the other conductor and goes in the other direction for a safe distance covered by insulation. That I think is the method that will be practiced most generally. You will understand that the circuit is only taken off at four places—at the four central distributing stations, where the current is reduced to 2,500 volts, and then distributed for house lighting. The current which goes to the houses is secondary, not primary.

Judge Armstrong: So if you got a shock it would be only 2,500 volts instead of 10,000?

Mr. Law: What arrangement do you make for connecting to a 2,500 volt circuit? Even taking a 1,000 volt circuit and attempting to make a connection on a wet day is rather a hot process.

Mr. Haskins: Yes, it is. It is not intended that any connection shall be made while the circuit is alive. Of course it would be in this way: If a store was to be taken on the connection would be made when that portion of the circuit was not in use. That is the method that Mr. Ferranti has always followed. They do not attempt to handle the 2,500 volt wires when they are alive. I have handled them myself when they are alive, and I have handled 10,000 volts when it was alive, too, but I do not like to.

Mr. Law: As I said before, we have to burn lights continuously. The current has to be on for twenty-four hours in the day, unless you make an auxiliary line for it, and the expense would prevent us from doing that. Now we have to connect our converters on the live wires, and we cannot wait just because it happens to be a little bit stormy. That storm may continue for two or three or four days. As I say, it is almost impossible to connect on a 1,000 volt circuit under those circumstances, and I wish to find out what arrangement has been made for connecting on this higher voltage without danger to the man doing it.

Mr. Haskins: Where it is found necessary to make connection when the circuit is alive they take out the double plug fuse on the primary. The fuse can be put in with safety when the current is alive. That is the primary tube.

Mr. Seely: I would like to state in response to the inquiry of the gentleman from Denver that the Manhattan Electric Light company of New York City have an ingenious way of connecting from the primary to the converters. They place the primaries in front of their houses into binding posts, and those binding posts are insulated. In case a subscriber is put in they put in what they call a primary switch, and after the installation is made and the lamps installed all that is necessary is to close a switch. They have placed those switches in all their lines now, as the fire underwriters have requested it.

Mr. Law: I may be a little thick-headed but I do not get at just what I wanted to know, and that is how they make the attachments directly to the primary mains. I have done it, connecting converters by using a plug or switch, but the trick comes in putting the leg on the primary main to get at this plug or switch or binding post, or whatever you use. What I want to know is how we can connect that primary loop to the converter on the main of the primary and not get the shock that we are liable to get provided there is leakage on the lines.

Mr. Seely: I would not advise any one to attempt to make a connection with a primary with a 1,000 volts. It is a well-known fact that it is being done every day by legging on the primary with rubber boots, rubber gloves, etc., but I know of no well known means by which you can avoid receiving a shock if the poles happen to be damp or you are standing on the sidewalk. They handle some very high tension currents in New York City, and I do not think we have had any deaths to the present time, but it is only a question of time.

Mr. Haskins: I might say that during my connection with Mr. Ferranti, although we were running a very large circuit from the Grosvenor gallery we had only one death in connection with the system, and that man was killed by being carried around the pulley by the rope gearings, so that the 2,500 volts was not responsible for that. It is not Mr. Ferranti's intention that the wire should ever be tapped when alive. Mr. Ferranti does not keep his wires alive constantly. He generally opens each circuit for half an hour every day. I have known them to be open for a little longer than that.

Mr. Bradley, of Fort Wayne: I would like to ask Mr. Haskins what is the rate of alternation—how many periods per second? What is the standard?

Mr. Haskins: I do not know.

Mr. Bradley: I find according to the number of pole pieces and the rate of steam that the small machine is about 11,000 reversals per minute, and the larger one is only about 7,900—something like that. I should think that no two machines could be placed on the same system so far apart.

Mr. Law: You found that difference in frequency between the 1,500 horse power machine and the 10,000 horse power machine?

Mr. Bradley: As I understood you, forty pole pieces and 280 revolutions for the smaller machine, 60 revolutions and 132 pole pieces?

Mr. Haskins: I find that I have not given the speed of rotation in the 1,500 horse power machines. I gave the rate of rotation on the Grosvenor gallery machine of 625 horse power, and I gave the rate of rotation of the 10,000 horse power machine. The frequency of the 10,000 horse power and the 1,500 horse power machine would be the same.

Mr. Pope: Walter B. Phillips, an old journalist of Providence, said he once thought that one of the unsatisfactory things about journals was that they sent stuff broadcast through the world and you never knew whether it was appreciated or not In view of that I wish to offer the following resolution:

Resolved, That the sincere thanks of the National Electric Light association be and the same are hereby tendered to the publishers and staff of the Providence Journal, Providence Bulletin and the Providence Evening Telegram for their very complete and accurate reports of the proceedings of this convention which have appeared during our sessions in this city.

The resolution was unanimously adopted.

Mr. Perrine: There is a very excellent system of rope gearing in use in this city, on the cable road, at the power house, which I have no doubt there would be no objection to the members seeing if they should care to go over there.

Mr. Haskins: In that connection I should like to ask the gentlemen what kind of rope they use?

The President: They use manilla rope. Now, we will listen to a paper by T. Carpenter Smith, on Distribution and Care of Alternating Currents.

Distribution and Care of Alternating Currents.

By T. Carpenter Smith.

I feel some reluctance on speaking upon this subject at all, because I have already spoken upon it at two or three conventions; but it has been brought to my notice that while a good deal of it is an old story to some of us there are new stations starting up every day, and it is to those people that I address myself more particularly. I want to keep them from falling into the same holes that we fell into, and I do not think there is anything that has hurt the business more than the failures in it—I do not mean the practical or the working failures, but the commercial failures. The men who put their money into those original plants, without any knowledge, and who did it on the faith of their engineers, only to find that they did not get a sufficient return from it, are not only loath to spend any more money themselves, but they exercise a very bad effect on others when we try to influence new capital.

I will begin by stating that there are a great many points covered in the care of the alternating currents as used for electric lighting that apply with equal force to all others at present in use for commercial purposes. It is always the unexpected that happens, and no doubt many points arise in practice which are never known outside of the station in which they occur, being treated as matters of course. If, therefore, I seem to omit any point which should be covered it must be remembered that it is my intention as much as possible to avoid recapitulation in such cases, and only describe some peculiarities of alternating current distribution which render certain precautions especially necessary and valuable.

To more easily arrive at these it will be well, however, to briefly state the different forms of electrical currents now in commercial use and what we may call the governing characteristic of each. I leave out those which come first in the history of the question; namely, telegraph, telephone, district call and fire alarm current. They are only worthy of note for their generally poor installation, the telephone lines especially being a perpetual nuisance to all of the others. This arises chiefly from their being of such light gauges of wire that they will not stand any exceptional strain such as is placed upon them by sleet storms or heavy gales, while the effect of rust and deterioration from atmospheric causes rapidly reduces them to the point beyond which they will not carry their own weight. I need not say that the moment they fall upon any electric light or power wires, they become a menace not only to the company operating the wires on which they fall, but themselves become dangerous to passers-by in the streets who have not yet learned that any dangling wire is worthy of avoidance.

Perhaps the strongest reasons why these wires are present in such overwhelming numbers in most cities is the fact that their value as "scrap" material will not pay the cost of taking them down; in other words, a short-sighted policy decides that it is cheaper to leave them up, and they are abandoned until they either fall down or are taken down by some other company which has reason to fear them.

The first that we consider of the currents now in general use from central stations are the "arc lighting circuits." To take the most powerful current generally operated on this system we may place it at about 10 amperes, and from 2,500 to 3,000 volts on a single wire. In this current we have, as a rule, the governing characteristics of a very high tension, but with small volume; and it may be well to note the particular form of danger to which it gives rise. Its high tension makes it dangerous both as to life and fire from its liability to leap through the insulation, and when the current has once been started to form a long arc. On the other hand, the danger is limited by the fact that the volume of current is small, and that the short-circuiting of the line by any other conductor tends, as a rule, to simply put the lights out rather than to cause any great danger at the point where this happens, while nearly all the machinery of this type in general use automatically reduces the energy supplied at once.

The chief points to be guarded against in these currents are, therefore, practically covered by the general precautions of good insulation and protection against leakage by moisture reaching the wires, while the danger to life is very largely eliminated by the usual practice of placing all lamps and appliances well out of reach of the public, and confining their care entirely to employes who are presumably skilled, and who will, therefore, handle the matter intelligently.

In the second great division of electrical currents which we consider, the low tension direct current system, the ruling feature is the large quantity. We may say that this current is practically not dangerous to life, but very dangerous as regard fire if not properly installed and protected. It is, however, a simple matter to properly protect these wires, and the low tension not putting any great strain on insulation, we may regard it as fully covered by the ordinary rule of the fire insurance underwriters, who, in this respect, owing to the nature of the business, have even more interest in the saving of property from fire than the central station itself. The great danger, however, lies in the fact that the volume of current is so great that any short circuit on the main lines developes an enormous amount of energy, at the point of accident, sufficient—on the authority of Mr. Edison himself to "reduce the pavement to a molten mass for many feet!" The general public almost necessarily have considerable care and control of the distributive appliances, and in their ignorance will often put grounds on the wires, or replace fusible plugs by copper wires; and this all has to be watched for.

And that is a danger that I think central stations ought to interest themselves more in. In Philadelphia we have got to a very good point with the fire underwriters, and they keep inspectors constantly at work; they do not merely inspect the work when it is being put in, but they go to a man's building at odd times and look all over his wiring again, and if they find any such foolishness as copper wire replacing fuses they will very often order his lights to be taken out; and it has only taken one or two instances of that kind to awaken the public to the fact that there are rights which the central station has, and there are certain precautions which they themselves must take.

The third great branch, and the one with which we more particularly concern ourselves to day, is comparatively a new one, but has in the short time it has been in existence, had so phenomenal a growth that it is no wonder that we find even the commonest precautions oftentimes neglected in its use.

In the alternating or converter system we may say at once as regards the secondary distribution, that the rules already laid down for the installation of low tension direct current wires will practically cover the case. The alternating current of fifty volts, which practically is the standard to-day, will work successfully with insulation, and under conditions which would lead to trouble immediately with even the one hundred volts direct current; and this fact in itself often leads to poor work, either from intention or ignorance. The wiring, of course, must be proportionately heavier for this current than for the direct, which perhaps adds some slight risk of undersized wire being used; but this is an evil which will generally correct itself owing to the diminution in light, making itself felt before the danger point is reached. The fact, also, that the converter cuts off all connection between the consumer and the company removes the great danger of grounds on one building affecting the whole system.

There are certain peculiar features, however, which should not be overlooked; namely, that moisture will often cause sufficient leak in the way of short circuit to heavily overload the wires, while not sufficient to start the "dead" short circuit, which would blow the fuses. For this reason special care should be taken that the wires are properly "fused," and that in the event of a fuse persistently blowing with only its proper number of lamps, search should be made for leaks.

The general tendency in the electric light business being now very largely to make the consumer responsible for all the wire upon his own premises beyond the converter, narrows the subject down to that on which I wish more particularly to speak—high tension alternating current distribution. This current has to a certain extent the governing characteristics of both those mentioned above, and

this has excited a disproportionate fear of it. Its tension of 1,000 volts (to take that oftenest used) is high enough to make a first-class insulation necessary as a precaution against leaks, which may soon break out altogether, and its being a constant potential system allows the whole power of the dynamo, or rather of the engine driving it, to be possibly developed at any point by a short circuit.

Without going into the fiercely debated question of direct vs. alternating currents, I would call attention to one fact: With high tension "direct" currents I have seen linemen, in repairing lines or cutting in circuits, handle an arc circuit of perhaps 2,000 volts when they should hardly touch it, and by taking a quick hold and keeping it, make a connection while really in a position of great danger, since a ground coming on the line elsewhere would surely kill or injure them, though they would not believe this since they could only feel the current at the moment of taking hold or letting go. With the alternating, however, the effect is constant, and so intensely disagreeable that a very slight leak, indeed, will discourage any one from running the least risk on live circuits. I may mention in this connection that as far as my experience goes, and I believe some of the learned doctors agree with me, the action of a heavy shock of alternating current is to force the diaphragm up into the chest compressing the lungs, and literally squeezing the breath out of one, causing the cry which seems peculiar to those caught in this way. If the person is stunned, dash cold water on the face and chest, loosen the clothing, especially at the neck, and use artificial respiration as for the drowned. One of our linemen who was badly caught was brought around by these means, after being to all intents and purposes dead for nearly ten minutes, no breath or pulse being visible.

Coming now to my subject proper, the first precaution which I think we should take in any case is to properly lay out a system of distribution according to the circumstances of the installation. Almost the first point to be thoroughly settled is the size of unit dynamo which it is proposed to use. This should be kept as large as possible, for the reason that practically a large dynamo takes no more care to look after it than a small one, while at the same time care must be taken not to get it too large, since an underloaded dynamo and engine is not economical to run.

The second point is that as alternating current dynamos are easiest run separately and not in multiple arc, the planning of pole lines, feeders and mains for various circuits should be such that these units can be economically used.

Another point to be looked at in the general plan is that wherever possible the sizes of mains and feeders should be kept the same throughout, thus reducing the number of sizes of wire used in street work, and keeping the pole lines and fittings as uniform as possible.

It is astonishing how few different sizes of wire are really needed if care be used in planning, for it is always a good fault to keep the sizes up both for mechanical and electrical reasons

It must not be forgotten that however much we may be able at the present, or have been able in the past, to control the condition under which we shall supply the public with any article, it is only a question of time when the public will decide for themselves, not only under what conditions, but in what quantities and under what prices they will take what we have to supply.

In the early history of electric lighting, and we may say even to the present time as far as arc lighting is concerned, the contract basis will be the one upon which the light is sold. With incandescent lighting for many years the contract system seemed to be the basis but as soon as a good and reliable meter was placed upon the market, that moment the conditions were changed.

It is a part of our human nature to desire only to pay for that which we use, and it is equally a part of our human nature to try and get something which we have not paid for, and for this reason there will always be those who desire the meter system and those who desire the contract system, but the weight of public opinion is so heavily in favor of the meter system that we may, to all intents and purposes, consider it as the adopted method of sale.

Electric lighting is after all only a lighting business, and those who are concerned in the furnishing of incandescent electric lights will learn many a valuable lesson from the gas companies, who, as I have more than once reminded you at these conventions, did not reach their present methods and conditions by having them schemed out at the start, but through much tribulation and many trials, so that their present methods are simply another instance of the survival of the fittest. For these reasons in deciding on unit sizes remember to count on probable load and not on probable number of lights rented.

To begin with the dynamos—we may say that the best unit to use will be probably found by taking the maximum all day load In some cases, however, this will be very light compared to the loads thrown on during the "heavy hours," and in such cases it may be better to use a much larger machine for the sake of uniformity with its many advantages. If multiples of a unit are used, only one or two spare parts need be carried—the feeders and mains can be all laid out alike, and any dynamo is ready to take the place of any other without any preliminary cutting and changing of circuits.

The question of sub-dividing power is a vexed one, and one on which we can never hope to see all agreed, and I therefore do not make any suggestions beyond noting that a dynamo which can pull up its driving engine without injury to itself is a good thing. That running a small engine as a relay is cheaper than running a large one, and that in incandescent lighting the customer, not the central station, regulates the load. Of course these remarks apply only to engines of the same type. I do not set a small high speed single expansion engine against a large compound or triple expansion one.

Keep dynamos well insulated, but put collectors to lead off the static electricity from the bolts. If there is a slight leak on one of your circuits, the easiest path for the spark may be to jump into the armature and so to line and ground, and this spark will punch through almost any insulation, and gradually keep making it weaker till some day the current generated in the armature follows the spark and your armature is gone. Look carefully to all screws and bolts; the alternating current seems to have some peculiar effect (perhaps by mechanical vibration, perhaps by actual molecular expansion and contraction) in loosening screws, causing small arcs which may melt off connections, or may make bad contacts. Nothing is more annoying than to have a dynamo operating perfectly until shut down, and then refusing to start up again. This comes often from such poor contacts—the current following and bridging over as long as it is kept going, but failing to make the first jump necessary to start. In arc lighting machinery this used to be got over by "jumping the machine" or short-circuiting it for an instant; and I have known alternating incandescent dynamos ruined by being served the same way.

A small air pump and tank with lines of pipe through the station and a hose to direct a strong jet of air into the armatures will be found a valuable addition to station equipment, and the amount of dust and copper which can be blown out after the hand bellows has done its best, is surprising.

Have your switch-board so that circuits and dynamos can be easily and quickly changed.

One feature which Ferranti seems to have early foreseen, and which in our American practice I think has been somewhat neglected, is the use of fuses with a very much greater distance between the point of attachment, and some ready means of replacing these fuses without danger to the persons so doing, even if the short circuit should still exist on the line which is being handled.

For this reason also it is a great mistake to crowd switch-boards too closely. There could be abundant room given both for the operator to stand in front of the board and to beat a hasty retreat without the danger of being caught by machinery or bolts behind him, and to allow the free use of hands and arms without the danger of being burnt by fuses in the immediate neighborhood which may go off at any time. While an alternating current will not make much of an arc when a fuse melts simply from overload, it does make a wicked and demoralizing one when a short circuit is present, especially when it has a heavy machine behind it.

There will always be some hesitation, I think, as to the adoption of devices for putting in fuses which do not have positive contact, such as a screw connection, or one which I think Ferranti used, a plug which can be twisted in at every application, thereby keeping the contacts clean. I think, however, that we shall soon see a fuse adopted which shall be in the form of a switch which can be opened and closed as often as needed to keep the contacts bright and clean.

In fitting up the fuse blocks and switch-boards it is well to leave no points or sharp corners exposed, since the alternating current will jump from such points if it be trained across or induced to do so by the presence of the lead vapor from a fuse which has blown.

It was one of my earliest experiences to see an arc jump in this way, from the ends of wires which had been pushed so far through the connections on switches as to show their ragged points beyond the metal of the switch. The arc which has formed on a blowing-out of a high tension fuse bridged over two such points a distance of nearly ten inches and held there for some fifteen or twenty seconds, in which time it has pretty thoroughly melted up the brass parts of the switches. In this case the arc had been started by throwing in a 100,000 watt dynamo on a short circuit.

While high insulation is needed on a switch-board which leads many to the use of rubber wire, I would say that I think a far greater danger is introduced by its use, namely fire. On an incandescent board, fuses may go at any moment and draw a heavy arc with them If coverings and fittings be used which will not carry flame, all is clear for new fuses in a few seconds; but if once fire starts and the other fuses let go, there is no saying where the damage will stop. While the voltage was enormously higher, and we do not know under how much more difficult conditions they labored, the destruction of a switch-board in the Grosvenor gallery station in London, and the consequent shutting down of 30,000 lights is a warning which all should heed.

It is always best not to have wires concealed anywhere about a station, and they should be run on porcelain or glass insulators so as to be perfectly safe from fire even if they should be soaking wet. With wires running this way there need be no fear of throwing water on wood work which is in danger of catching fire, since the worst damage that can be done would be the blowing of the fuses from a short circuit. Of course the covering of the wires should be of a kind which will properly protect those who are working among them. A separate ammeter and voltmeter on each circuit or feeder, while apparently an expensive luxury, is in reality a very great saving and convenience in a station which has lines over a half mile in length. The ammeter enables one to tell precisely on what feeders the load is heaviest; and where more than one feeder runs to any district it is a convenient means of knowing just upon what circuit to cut in the lights for any new customer. If the system in use allows any compensating device for indicating the correct voltage at the point of distribution instead of in the station it will be so much the better; and also to have on all feeders if possible, but certainly on extended ones, some arrangement for raising the electromotive force in order that both short and long feeders may be operated from the same dynamo. Of course there are many cases where it pays to run a separate dynamo at higher voltage for a particular feeder or set of feeders on which there is a heavy drop. But even in such cases it is often useful to be able to run these feeders with those on which the drop is small from the same dynamo.

Put pilot lamps on each feeder, which will often attract attention to a circuit being out quicker than a voltmeter; and put pilot lamps also on each field circuit. If separately excited dynamos are used, put pilot lamps also on both the main circuit and field circuit of the exciters. These pilot lamps need not of course be up to candle power; high resistance lamps or lamps placed in series will be quite sufficient, and the amount of current they use inappreciable while the saving in time which the lamps afford in case of any failure of current by enabling an atendant to locate the trouble at once between certain points is often considerable. Thus if the pilot lamps on the main feeder and on the field circuit of the alternator have both gone out while the pilot lamps on the exciter mains and exciter fields are still lit, it shows that the trouble is somewhere between the pilot lamps on the field circuit and the exciter mains, being probably loose contacts in the switches, or something of that kind. If the pilot lamps or the alternator only have gone out there is no use looking for any trouble about the fields or the exciter circuits, since the pilot lamps being lit there shows at once that the trouble is further on in the chain of connections. It may seem a refinement to put in such arrangements for the sake of saving a few minutes or even seconds in locating troubles; but it must be remembered that the public are more and more demanding that incandescent lighting shall be as continuous and reliable as any other method, and when all the lights in the building go out at once, a few seconds' delay may be a very serious matter. The public are not concerned with what the cause of the trouble may be, but only have one question, "Why do I not get the light that I pay for?" and the man who rents one light is often more troublesome than the man who rents a thousand.

Separate exciting I think will be found to give the easiest handling of dynamos, and also has the advantage that as long as the alternators each have their independent rheostat, the regulation of the exciting current regulates all the lights with very little trouble.

For small stations self-exciting machines have their advantage since it gives less actual machines to look after; but I doubt whether this advantage is not more than covered by the fact that it is a simple matter to carry a spare armature for the small exciter, which can be slipped out in a few minutes, rather than to have to change the heavy armature of an alternator because of some slight trouble with its exciting coils or commutator.

While alternating current dynamos are best run separately, and the need of synchronizing is not often felt, when it is wanted it is wanted badly, and it is a good plan to carefully speed all machines and engines so that they will all run at one speed when light, and at a certain increased speed when loaded. This can generally be done with separate engines by changing the governors, and where shafting is used, by slight changes in pulley diameters, and this will enable the dynamos to be run together if required, with as little trouble or danger as may be.

The keeping of a careful log in boiler, engine and dynamo rooms I need hardly refer to; for some years now in the larger and better equipped stations it has been customery to weigh the coal used under the boilers and to keep an hourly or half-hourly record of the load upon each dynamo and feeder. Now, that reliable meters can be had for use on high tension circuits, I think it would be a matter of the greatest importance to have one of these meters placed in the circuit of each separate feeder, since by that means we are enabled to check up the differences between the amount of current furnished to the feeder at the station each month, and the amount of current which is charged to the various customers on that same feeder. There is nothing more than the station meter of the Gas company and its value as a means of detecting leakage on the lines, whether from bad insulation or from theft of current, cannot be over-estimated.

One point we must always keep clear before us and that is as long as the contract condition of selling light existed, the cost of making this light did not bear so unvariable and fixed a value with reference to the profits of the station as it does where a meter was used.

With the contract system there might be many contracts made for the use of a certain amount of light, which amount of light would not be used, resulting in a direct profit to the company, which in such cases received money for what it did not furnish, but with the meter system the only receipts of the company are for the current which is delivered to the customer and the difference in the price charged to the customer per watt-hour and the cost of producing this current per watt-hour, is the measure of success or failure.

It is, I suppose, hardly necessary to refer to the advantages of keeping careful records of dynamos and converters and all repairs to them. The advantage of such a system of records can only be appreciated by those who have used it. There are certain classes of machines in which armatures will last without giving a sign of trouble for from 2 to 3 years, and then one coil after another will commence giving out. It may be found that when a machine has been running for perhaps a few months and a coil gives away, that this coil may have given out from some local defect or injury in itself, and it will be worth while to repair only this coil. On the other hand, if at the end of four years a coil gives out, and then a month or two later another coil, it may pay better to rewind the whole armature rather than to do any patching, since the chances are that the whole armature is weakened and will keep on breaking down until the whole has been rewound anyhow. The same with converters, there will occasionally be found a converter which is always in trouble. It may keep blowing fuses or burning out switch boards continuously, and in a short time the extra cost of taking care of it would soon amount to more than a complete repair.

I do not mean to include in the regular repair book such small items as the placing of fuses; but it is astonishing how much can be learned about converters by persistently following them up. The meters which are now in general use cannot be too carefully watched. There are numerous little troubles which arise with them chiefly from poor contacts and dust. By keeping a careful record of the readings of each meter from month to month a great deal

may be learned about them, and some of the apparently unaccountable changes in their records traced up.

Among some of the minor points which must be looked out for are first to see that spiders and insects do not get into them and stop their motion, and, secondly, that the growth of electrical knowledge among the customers does not tend to make them try to beat the meter. We have found cases where this was done by drilling a very fine hole in the case of the meter and dropping into it a fine wire which should touch the vanes and so stop the meter recording, this being done for perhaps two weeks in the month, so as not to arouse suspicion by a total cessation of the record, while at the same time allowing a wide interval of time during which the meter inspector might call without detecting the presence of this wire.

The short-circuiting of a meter has been practiced to some extent, but this can usually be guarded against by running both wires to the meter under moldings, which as a rule the customer does not care to meddle with. In one type of meter we have seen large pieces of iron placed beside it to interfere with its record, and this will affect ,I believe, almost any mechanical meter. The electric meter being as a rule placed like its cousin the gas meter in the darkest and most inaccessible spot in the building, is not always easy to keep closely watched, but if it is a few good examples will often do away with a large measure of the trouble.

To take up the second great branch of my subject, that of the "Outside Distribution," let us return to the point where we spoke of the importance of outlining the plan and lay-out of the circuits, in connection with the decision as to the size of a unit dynamo.

For the outside distribution, the first point that we have to consider is the question as to whether the wires are to run overhead or underground. Without expressing any preference for one or the other I would mention a few points in each which should be most carefully looked after before deciding upon the use of either. If underground work be possible, what advantage do we gain by its use? We may say that we practically get rid of all the trouble connected with storms and fire and other incidents of like nature. We also remove a great deal of public clamor against the use of electricity, and we avoid the annoying interruption to work which goes on from the mere fact that our operations have to be conducted in full sight on the public streets. We also, to a certain extent, get a kind of claim upon premises where the current has been introduced undergound, since, as a rule, the connections are not visible from the outside; and when the current has been cut off we are not required to remove them as is often the case with overhead wires. All things considered, the maintenance of underground cables would probably be less than that of overhead wires, providing that the fixed charges due to the enormously increased cost be left out, since accidents to overhead lines generally occur together, from storms, etc., compelling the carrying of a larger force of wiremen, or a proportionately longer time to make repairs.

The greatest disadvantages of underground wires are undoubtedly the uncertainty as to their life, both from want of experience and from ignorance of the exact causes which lead to their destruction; and also that their enormous first cost raises the cost of the production of the electric light to a point which compels us to charge the public more for their light than they are inclined to give, which fact in many cases actually prohibits its introduction. A very peculiar series of phenomena is introduced when wires are placed underground in such close proximity to one another, as they necessarily must, where a large number are run in conduits together, and these results are not very well understood so far even by those who have had the most experience with them. I may cite as an instance of this, the effect which has been observed in Mr. Ferranti's 10,000 volt mains from the Deptford Station, where the electromotive force at the London end is higher than that at the generating station. There seems to be some doubt as to what causes this condition, and so far some controversy over it, though it would appear from recent utterances to be fairly well proved that it is due to static capacity. One thing seems certain that a similar effect has been observed on some overhead lines; but in the latter case it has been sufficient to interfere with good running.

If the overhead system be determined upon, nothing but the very best construction should be used. It must not be forgotten that the majority of accidents which have occurred from overhead wires have nearly all been caused by poor construction. I do not think I am far wrong if I say that all accidents which have occurred to others than employes of the companies have been caused either by poor construction or gross carelessness on the part of those injured. With employes the case is somewhat different. Undoubtedly many have been killed by their own carelessness, but there is a certain class of accidents which occur to the most skilled men and under the most extraordinary conditions, which must be put down simply as true "accidents," and against which no better provision can be made than by careful construction and inspection.

I think if I detail the method which was followed in laying out the feeders for a large central station a modification of this will be probably found in most cases.

The bulk of the lighting was expected to be on two main streets of the town running parallel with one another on a long curve for about a mile and a half, and the central station was located about halfway between the center and end of the line, and about one-half mile distant from the nearest of the two streets. There were five cross streets available running from the central station in almost a straight line to different points of the main lighting district, and the question was raised as to which would be the best to use for running the main feeders. Approximate calculations showed that the full load of the largest machine proposed, 3,000 lights, could be carried between any two of these cross streets or feeder junctions with the maximum drop proposed, if No. 3 wire were used for the mains. It was therefore decided to use a No. 3 wire continuous from end to end for the mains to start with, proper arrangement being made to cut this main into sections as fast as the load should increase so as to render the splitting up of the load on to one or more machines necessary.

To determine the size of feeders the only point raised was as to which was the heaviest wire which could be run upon poles, and handled easily. It was determined that No. 0 Brown & Sharpe would best fill the conditions, and five lines of No. 0 Brown & Sharpe wire, one on each street, were run up and tapped into the mains at the junctions of both streets. The maximum number of amperes that could be carried by each feeder with two per cent. loss was then calculated and marked on the feeder at the switch-board and on the plans, thus: No. 1 feeder being the longest would only carry 22 amperes; No. 2 feeder would carry 40 amperes; No. 3 feeder would carry 80 amperes; No. 4 feeder would carry 65 amperes, and No. 5 feeder would carry 30 amperes. These would all run to one switch-board, and as soon as the ammeter on any one of these feeders showed that the maximum load during the night's run reached its limit a second No. 0 wire would be run on this pole line and multiplied with the first, doubling the capacity of the feeder at once. In the same way as long as the total load on all the feeders did not reach above the first 3,000 light machine installed, the mains were left continuous; but as soon as this limit was reached the mains were cut at such a point as to about divide the load into two parts, and two machines were started.

This progress will be kept up indefinitely, the feeders being always kept below two per cent. loss, and the mains cut to accommodate the unit of 3,000 lights of dynamo capacity.

The feeder which had the smallest available load, No. 1 carrying 22 amperes, happens to be the feeder which runs to the district where the fewest lights are expected, and in all probability will never be doubled up, the district being thinly populated and with no immediate prospect of its being built up very much.

In this plant another detail was introduced of making the breaks in the mains by means of switches, so that in the event of a break-down of a feeder line the closing of these switches would enable the lights to be taken care of by the machine on either side.

The plan in fact makes the whole system of mains one large switch-board, allowing for the transfer of lights up and down the line among the different sections.

In laying out long feeders try and keep those which belong to different circuits as far apart as possible, since wires which run parallel with each other for long distances will cause interference, especially if the voltage of one circuit be considerably higher than that of the other, and still more if the static capacity of one be much larger. In putting in new lines be very careful to avoid the effects of induction from live circuits which sometimes rises to an unexpected degree. I have known of a case where men received a heavy enough shock to throw them down in taking hold of the bare end of a wire totally disconnected in every way from the circuit, but which ran parallel for about a half mile with a 1,000 volt feeder. Had these men been handling a bare end on an iron pole they might have received shock enough to throw them down, and injure them seriously from the fall, when we should have had another "mysterious accident" with electricity. In placing converters, while in many cases they can be placed with perfect safety inside of buildings, they can generally be placed outside in positions where they can be got at easily for re-fusing, and without disfiguring the buildings to any extent. A very good rule is to allow no porcelain insulators on out-door work; nothing but glass put on iron brackets so made that the glass can always stand upright to prevent filling with water. No loops should be allowed to be cut in on the circuits between poles, but all connections should be made at a pole. And in the case of converters placed inside buildings, a double pole switch should be placed at this point, though I should not think it absolutely necessary in the case of converters placed outside of buildings.

Run converters separately as much as possible, and if it is absolutely necessary to run them in multiple arc keep a close watch upon the fuses, since when run in this way converters have a trick of blowing fuses without any apparent cause. Never change a high tension fuse.

When converters are brought back to the station for storage they should be kept in a warm, dry room to prevent the condensation of moisture on the interior of the cases, which will damage them quicker than leaving them in service out of doors.

It must not be forgotten that the thoroughly sound over-head construction is the strongest argument which can be advanced to-day against companies being compelled to spend large sums of money on underground work. I have been so much interested in the pole line work done in this city that I have examined it with some little care, and I find some points that surprise me, though I was well aware that their construction was of the best, and I relate some of these points for your consideration. All new poles are made of sawed yellow pine, tarred where sunk in the ground, and painted above it; no less than eight inches square being used anywhere and the majority being ten and twelve.

The cross arms are not only heavy in themselves but are rendered even more so by the kind of pins used. These are not of wood, but are made by placing a large bolt with its head in the glass insulator and cementing it in solid with plaster of paris; these lag bolts being then screwed directly into the cross arm, avoiding the weakening of the arm by large holes bored into it and doing away with snapping pins.

All new wire strung is of high grade insulation, and all low grade wires wherever taken down are re-insulated with high grade insulation before being replaced. All joints in the line are soldered, and nothing but iron brackets and glass insulators allowed for outside work. Not only have the iron brackets been made for all situations, but they have been made in pairs so that the leading wires shall always be kept a uniform distance apart, which adds enormously to the trim and workmanlike appearance of the lines. I think all will agree with me that those who are willing to spend the enormous sums that such work costs have established a right to ask that they be not expected to do anything in the way of underground work until underground work has been demonstrated as successful in every way as the work that they have done here; and more than this, that such underground work shall possess decided advantages to compensate for the increased difficulty of locating and correcting trouble in which respect the overhead line is undoubtedly far superior.

If municipalities wish to place themselves in the front rank of progress, and at the same time encourage local industries let them rather expend their energies in insisting on and compelling the proper carrying out of well-tested methods of construction rather than in demanding that untried principles and methods be experimented with often under conditions which preclude their success.

Discussion.

Dr. Mason: You refer to the practice in Great Britain. I remember Mr. Musgrave told me he would not permit them to be outside of the building.

Mr. Smith: There is one reason for that. I was very much surprised in reading over some of the Board of Trade rules in England, that converters must be inclosed in a tight wooden case or tight iron case, or something of that kind, and we now find that the English practice is not to put the converter, as sold by the company, in an iron shell. In the Ferranti converter, as Mr. Haskins has described it, it would appear, the laminated iron is exposed except when the converter is specially inclosed. Now, all the converters I have seen of American manufacture have had that outside shell entirely separated from the laminated iron and forming no part of the electrical equipment of the converter, but simply a mechanical protection outside. The water would very soon destroy the European converters without that outside case.

Dr. Mason: I would like to know from Mr. Haskins whether they have had any case of serious trouble with their method of installation in Great Britain, that is, putting the converters in buildings. I could not see that any special method was used as to placing them. I found them up stairs in the cupola, down stairs in the cellar, in entries—wherever it seemed most convenient to place them. Almost everywhere, except in Philadelphia, it is forbidden that they should be inside any building.

Mr. Haskins: To my knowledge, there has been no trouble whatever with tranformers in buildings. I think our practice was almost invariably to put the transformer in the cellar, which does not seem like a very favorable place. As Mr. Smith has said, the Ferranti transformer is not entirely inclosed. About two-thirds of the lamination is inclosed. But the internal insulation of the transformer is very perfect and the wiring has to be according to the regulations.

Dr. Mason: If there has never been any trouble from a transformer in a building in one city, I cannot quite understand why they should be absolutely forbidden elsewhere.

The President: When we first introduced the system here we had a long talk with Captain Brophy about it. He was the supreme power. He said there was no reason why the converter should not be put in buildings, and yet he did forbid it, and his only reason was that, with the converter working warm some of the insulation might smoke a little bit and some one might cry fire, pull the fire alarm and call out the department. I believe we have lost one converter only in the hundred we have up here in town. It was mechanically defective.

Mr. Smith: We have been accustomed for some years to regard slate as the best material for switches, etc., but within a short time I have had an annoying accident owing to the presence of mineral in the slate. I find that the pure white Italian marble can be had in blocks without any mineral in it whatever, and it seems to me as though that would be the only substance that could be thoroughly depended on. But that will, of course, be quite expensive. For that reason I somewhat favor putting all switches and cut-outs and work of that kind on marble or porcelain bases, but making the switch-board itself of wood and allowing no wires to be clamped directly to it—keeping everything off the switch-board two or three inches. An air-space of three or four inches will protect your board pretty thoroughly against fire. With a board of that kind, if there were danger of catching fire I would not hesitate to turn the hose on it.

Dr. Mason: Did I understand Mr. Smith to say that on a switch-board he would use none but an absolute water-proof insulation?

Mr Smith: No, sir, I said nothing about that. I want an insulation that will not carry fire. Underwriters' wire has been very good for switch-boards for that reason, and it has been reasonably safe for men, because the switch-board is generally in the driest part of the station. Underwriters' wire, however, is not by any means what we ought to have. It is purely a makeshift. But we do want for switch boards wire which will not carry flame, which cannot be set on fire either by the heat of the copper in it or by flames striking it from the outside. On a live switch-board you have got to go in among the wires, and to take some risks. We want to make those risks as small as we can.

Mr Di Camp: Mr. Smith's paper is, in my judgment, the ideal paper for this organization. A great many members of this association will be better qualified

to discuss it after having read it carefully, taking it up point by point, than they are at present. I would suggest that Mr. Smith's paper be put on the list for discussion at our next meeting in the shape of unfinished business, if you choose.

MR. FRANCISCO: This paper alone ought to induce every central station man in the United States to join this association and come in here and get these practical points. I know of several stations that have been laboring and spending hundreds and thousands of dollars to overcome the very faults that he has pointed out here.

When I was engaged in getting information in regard to municipal ownerships for the paper which I read at Cape May, I spent a great deal of time in looking up central stations. I traveled from Maine to Colorado, from Washington Territory to the Gulf of Mexico, and examined almost every station in that circuit. Without wishing to compliment our President too much, I must say that not one single station have I visited that I thought compared with the Narragansett station of Providence, taking everything into consideration. In the first place, it is substantial. It is based upon a right principle of extension, that is, of extending the business indefinitely almost. It is also constructed upon economical principles, which is a very important thing in our business. I fully concur in what has been said in regard to the pole lines.

Upon motion of Mr. De Camp, the formal discussion of Mr. Smith's paper was laid over until the next meeting of the association, and Mr. Law was requested to put in writing the views which he otherwise would offer in opening the discussion.

MR. SMITH: I would like to make an addition to my paper. I wish to say that if there is any city in this country that has done more to damage the electric light business than any other, it has been New York. I also wish to say that about one year ago in walking up Broadway I saw a converter of well-known make placed on the exterior of a building—laid upon its back on one of those wide window sills in a building where the basement was used as a business office. The wires from the secondary of the converter ran down through a rubber tube without any tape, underneath and into the basement. The primaries were connected to the main line with wire that looked to be of a very inferior weather-proof line wire tape and the tape over those joints was hanging in strips. Right by this converter was an iron stairway reaching to the first floor of the main building and any one could stand on that stoop and put his hand on the converter. After we had all this experience in New York and the fearful cutting of the wires, I naturally supposed that that would be one of the first converters to be swept away. Not two months ago I walked up Broadway and that converter was there still. No rules you can make as to putting converters inside and outside of buildings will make them safe when such criminal recklessness as that is indulged in.

MR. SEELY: I desire to say that I am not connected with any electric light company in New York. I also desire to say that in New York city they have a Board of Fire Underwriters, inspectors, a city electrician and all of the luxuries pertaining to first-class construction. Mr. Smith has described it. That is why I insist on these gentlemen formulating rules so that we shall know exactly what to do and how it shall be done.

THE PRESIDENT: The next paper is on Mutual Insurance of Accounts, by Frederick A. C. Perrine.

MR. PERRINE: I must explain the incompleteness, if not the inaccurracy, of this paper by the fact that the idea was conceived not very long ago and has been worked up as thoroughly as I cou'd do it without very extensive reading. As you all remember, the Baring Brothers of London, tried to float the Argentine certificates and failing in doing that, they came back so heavily on the Bank of England that the reserve of gold diminished and a panic was only averted by the loan of gold from the other governments. In this country the American certificates owned abroad were sent here in such quantities that in the face of the shaken confidence our people did not have the ready money to buy them up. At the same time the reserves of gold were withdrawn from the bank. Every one seemed to want to get in his own money and confidence was more and more shaken. Soon after that the Clearing House of New York issued certificates which merely amounted to saying that we believed that we were safe, and those certificates in the event of actual failure of the Clearing House would have amounted to nothing, but the banks were going to support each other. Shortly after that Edward Atkinson proposed at a meeting of the Boot & Shoe club in Boston that this principle should be applied to general life; that the money should not be essentially a gold value; that is the currency of the country should not be gold but the currency of the country should be clearing house certificates payable on demand in gold, and that the gold of the country should be kept in the bank reserved until such a time as it would be demanded and paid out. In that way, he says the currency will be ample for the volume of business in the country and the gold reserved in the bank, amounting to $600,000,000, would be ample for carrying on the business. At present we are attempting to carry on the business with that $600,000,000 scattered all over. Thinking of his paper I conceived the idea which I wished to present.

MUTUAL INSURANCE OF ACCOUNTS.

BY FREDERIC A. C. PERRINE, D. SC.

The recent financial crisis has been happily passed in a manner never before attempted or imagined in the history of business or banking. At any moment one of our sensation-loving newspapers, willing to handle fire, might have precipitated the whole country into financial ruin, by persistently teaching fear and liquidation, but, taking as they did, an optimistic view, they did not check the new force in banking, mutual support.

It may be objected to the use of the term new force, that "mutual support" is the very underlying principle of banking as it has always been practiced, but its application in approaching times of panic is almost new enough to be called a discovery. Mutual confidenee in ordinary times is but the belief that any one, when individually called upon, can at any time meet his current obligations, but the principle applied by the bankers of Europe and by our New York clearing-house, is essentially the belief in the solvency of the country, or the world as a whole. Two forces tended to bring about this happy result, one acting here and the other abroad.

In Europe the Barings were not the only bankers heavily involved in South American securities. They, indeed, were the heaviest holders in Argentines, and had taken the initiative in attempting to float them, but failing in this, the load became too heavy for their individual shoulders, and their fellows were ready enough to give them aid which would also protect the smaller holders, in which number is included all except one or two of the great bankers.

Six months or more ago, the possibility of a crisis had been foreseen by our bankers, some of whom are intimately connected with South American affairs. By them it was known where lay the greatest financial dangers, and that these dangers concerned us only indirectly, through our speculative markets, rather than through the ordinary channels of business. When the crash came, and the worst was averted by the ready loan of gold abroad, our clearing-house feeling that a lack of confidence was the one dangerous element, ventured upon the experiment of the issue of a new form of currency, namely, the clearing house certificates.

Now that the air is clearing and we look about us, we find among the most sensitive lines of business the industry of electric lighting. Very few of the companies are thoroughly on their feet as regards ready cash, being but young, and spending their earnings in necessary extensions; almost none are individual concerns, the majority being stock companies; and as a consequence, feeling immediately the waves of the market. Many, noticeably the electric railroads, were in the midst of initiative constructions, and just about to float their bonds; but we can proudly say that nearly all were, and are, looked upon as successful business ventures, safe enough while confidence lasts.

These considerations have led to the thought that, without looking to outside bankers or business men, the electrical business should form an association of confidence, capable of rendering them independent of the market if not even a stay to it in future crises. It is thus that we see an azsociation of confidence used by the bankers of the New York clearing house, and following immediately upon their action, the timely speech of Edward Atkinson before the Boot and Shoe Club of Boston, proposing its continuation as a general principle, and its extension to the needs of everyday life, in a money issued by the clearing houses, based upon the stability of the business men of the country, and backed by a reserve in coin, only to be called upon in time of greatest need. In the course of his speech, to show how little the risk, he cites the fact that, in his extended experience of business, the losses through bad debts have not amounted to one-half of one per cent. of its value; this low average, I believe, has hitherto been much too high applied, to the electric light and railroad industries.

If, in view of these facts, the electrical companies would form a mutual association for the purpose of insuring their accounts, the effect would be that of increased capital in the business, relieving their creditors of much of their anxiety, and rendering stable the stock and bonds of the associated concerns. The risk of an account is not greater than that of anything else for which insurance is granted; a man's life, or loss by fire, for instance, while resembling rather the latter than the former. It is a calamity which no man expects, and one to be guarded against by the most strenuous means. The loss, stated above, of one-half of one per cent, as incident to general business, includes not only the losses due to bad management and dishonesty, but also the failures occasioned by these very times of weak faith, against which this plan is directed. These being eliminated, the business losses of an electrical company could be reduced to a minimum, and dividing these losses among the many, would make them a burden to none, while conferring upon all the benefit of a practically increased capital of a credit money.

In detail, the plan should be to form among the electrical companies, a mutual assurance society, each company pledging individually its entire capital for the assurance of all accounts outstanding against any member, for which benefit a charge should be made covering expenses through administration or losses, proportionate to either the capital involved, or services rendered.

The assurance of the account could be effected in one of three methods, either of which would require elaboration and further study. First: The association might issue a series of promissory notes payable on demand, by means of which accounts could be settled, and which could be sold to various companies whose notes could be taken in exchange; this would involve a possibly expensive administration, and considerable ready capital, besides being probably liable to a tax imposed by the government on a circulating medium.

Secondly: The association might, without inquiry, insure all accounts, and be called upon only to adjust in case of failure. This would allow the greatest opportunity for dishonesty, and make it extremely difficult for the association to ascertain at any time its liabilities, except by a complicated system of bookkeeping involving the rigid inspection of the books of the insuring companies.

The third, which appeals to one as being the simplest plan, is that the association appear as an indorser on notes or an insurer for accounts when called upon to do so by any member, thus taking the position of a trust company.

In the case of any one of the insured companies becoming involved, action should be taken by the association, depending upon the contingent circumstances; in the case of a temporary embarrassment the notes should be paid to the holders on maturity, and the company carried by the association till such a time as it could discharge its obligations. Were mismanagement apparent, the association should have the power to enforce a more economical or honest administration; or if, finally the business were found necessarily unprofitable, the creditors should be paid in full and the company be closed out for the benefit of the association, No surrender of administration is contemplated here before such a time as the account could be shown to be in actual danger.

The insurance of an account may seem on first consideration to be rather a startling innovation in business methods, but I believe it to be based upon a firmer and more rational foundation than the insurance against loss either by fire or accident. Both of the latter are based upon a system of probabilities in which the insured expects his policy value to be greater than his premiums, and the success of the company proves it not to be true in the long run; the mutual insurance of an account, on the other hand, depends on the belief that all the accounts will be, in the main, stable, and that internal faith will induce a greater faith from the outside.

The objection that it is a scheme of the weak companies to be supported by the strong, and that they who would offer the greatest stability would not enter it, is answered in two ways: in the first place, as has already been said, the companies involved in the electrical businesses are in almost no cases individual concerns, and, as stock companies, are subject to extraordinary effects of bad and expensive management and fluctuating of the market; secondly, they are none of them so solid and stable as to be entirely removed from fear of depression, or need of funds for extension. Again, the very principle involved is that, as a whole, there are no weak companies in the business, if only times of depression be avoided.

To the objection that an unlimited liability company would be avoided by all, the same answers would be offered, with the addition of pointing to the Guarantee and Accident Lloyds, of New York, and Lloyds, of England, as stable examples of the application of the principle to ordinary insurance.

The initial subscription of the small amount of a few thousand dollars by each insurer, would be the capital needed, its only use being to meet imperative accounts while the administration would be of the simplest, requiring a minimum of efficient men whose services would be called upon to adjust irregularities and issue insurance.

The scheme is offered to the electrical fraternity, believing that by it the best interests of both the electric light and railway companies and the supply houses will be preserved, and that through it the electrical interests will not be a menace, but become a source of stability to the finances of the country.

DISCUSSION.

MR. DE CAMP: I was first struck by the title of the paper, which I could not understand, and I was very forcibly struck and astounded by the suggestions made. They were entirely new. I had not the honor of knowing the author of them, but I feel myself safe in assuming that he never had to manipulate the finances of an electric light station. It seems to me that it did not directly apply to the stations. He speaks of history when he quotes the late lamentable experience of the Barings. The Argentine Confederation was trying to do what the parent companies have been trying to do for the last two years—to bite off more than they could chew. Therefore, I look upon anything of that kind with suspicion. The fact is that the central station lighting companies need no protection if their foundation is on business principles. I do not take it to be the province of this association, or any other association, to insure against an insufficiency of capital in any business. Referring back to the late troubles, they grew, in short, out of overtrading in various directions. If there has been any need of mutual insurance of accounts among the people who have been looking to the central station for the payments of their bills, it has been the companies that have been furnishing apparatus. They have been doing just exactly what the South American states have been doing—they have been overtrading. They have been organizing companies where they were not needed. They have been promising profits which could not be realized. The parent companies, as we call them, or the manufacturing companies, are obliged to be creditors of somebody else. The competition among the manufacturers has led them to go beyond the bounds of good judgment in extending their credits. There is no mode of insurance that can protect any community against such business method.

MR. PERRINE: I am with the Roebling company. I have been an electric light man ever since I have been in business, and that is one thing that brought this subject to my mind. Our business last year with the electric light companies aggregated close to a million dollars, and out of which we lost one account amounting to $1,200, which was due to a man running away with the funds of the company. That shows to my mind very clearly that the electric light companies are on a firm basis.

THE PRESIDENT: The next item on the calendar is the report of the Committee on Data.

REPORT OF THE COMMITTEE ON DATA.

MR. DE CAMP: The report of the committee will be presented in two sections. Part first will treat of the subject of "The Dangers of Electricity" growing out of the action taken at the twelfth convention on the paper presented on this subject by Prof. Henry Norton of the Stevens Institute of Technology.

Part second will treat of the subject of "Standards of Economy in the Generation of Power" growing out of the action taken at the twelfth convention on the paper presented on this subject by H. M. Sweatland, editor of *Power-Steam*, New York.

Mr. Sweatland has kindly consented to assist this committee by preparing this section of the report, and to present it in person.

Conforming to the instructions given to it by the twelfth convention, two circulars of inquiry were prepared and sent out from the office of the association to all central station companies in the United States, for the purpose of collecting the statistics as desired. These circulars will be printed in the appendix of the volume of proceedings for this convention.

Replies to the inquiries regarding personal injuries to workmen employed by central station companies have been received from 213 companies. Of this number, forty-five companies failed to state the number of workmen employed, but report no accidents. One hundred and sixty-eight companies, employing 1,233 men, report seven accidents. This report covers the year 1890. It shows in 369,900 days' work only seven injuries. None of these injuries were fatal.

In the matter of fire losses, no data have been collected. I am desirous, however, to lay before the association an extract from a report made recently by William McDavitt, chief inspector of the city of Philadelphia. It is as follows:

"PHILADELPHIA FIRE UNDERWRITERS' ASSOCIATION,

136-138 South Fourth Street, Philadelphia.

"ELECTRICAL DEPARTMENT.—"There are over 5,000 buildings in Philadelphia wherein electric currents are used for light and power purposes. Of this number 287 buildings (7 of which are dwellings) have their own apparatus, the latter varying in size from a 20 light to one of 4,000 lights. The number of lights furnished by these private plants aggregates 80,258 incandescent and 3,325 arc lights. One retail store contains 482 arc lights."

"There are 15 public stations distributing electric currents to all sections of the city, furnishing thousands of lights and power to dwellings, churches and other classes of buildings. The numbers of lights supplied by these respective stations vary from the very small station furnishing 2,000 to the Edison which furnishes over 40,000 incandescent lights and current for a large number of motors. The electric motors in use are of a capacity ranging from ½ to 30-horse power (being used to a great extent as a substitute for laborious hand or foot power in dwellings and small workshops), and are being rapidly introduced as a more ready motor in place of steam and hydraulic power in propelling machinery."

"All of the different systems of electric lighting invented are or have been given opportunity to operate their respective apparatus in our city and, wherever consistent with safety, approvals were given for use in insured buildings. In innumerable instances, where no insurance was held on buildings, when electric lighting was introduced, contractors were required to install the work in accordance with the underwriters' requirements and subject to the approval of the latter's inspection.

No insurance loss occurred in any building in our city during the past year from fire where the cause could be in any way attributed to electric wires."

"The education of the workmen in the new factor, and the steady improvements made in materials and devices in electric appliances have materially lessened the danger in its introduction, but a like knowledge of the inherent danger in the use and handling of electric light appliances should be had with consumers or users."

Experience has proven that no perfect insulation can be maintained with the customary method of installing electric wires, where either the conductors or the covering are exposed to mechanical injury or deterioration from affecting influences that may arise, more especially when wires are concealed in inaccessible places.

In matter of injuries to linemen from electric currents and fires caused by the same, returns made to the United States census office from Chiefs of Fire Departments, the followieg statements are made.

Total number of towns reporting	307
Total number of regularly employed force	16,143
Total number of enrolled volunteer force	35,510
Total number of alarms calling out whole or part of force	30,862
Total number of fires caused by electric currents	363
Total number of injuries received while on duty	1,303
Total number of injuries received while on duty, at fires caused by electric currents	26
Total number of injuries caused by electric currents	25
Total number of fatal injuries	55
Total number of fatal injuries caused by electric currents	1
Total number of deaths from natural causes	338
Total number of towns in which firemen are supplied with printed rules for the prevention of injuries	1
Total number of towns having an electric fire alarm system	195

MR. DECAMP: Since this report has been written it occurred to me that in the case of Philadelphia which has no accidents to report, because there were no accidents of a nature that would come into a report of this kind, they had no relation whatever to the business. We had an epidemic of people falling off poles and I did not give it any more consideration than I would the case of a workman going home and falling off a street car.

The report was accepted and the committee continued.

COMPARISON OF ECONOMY IN THE GENERATION OF POWER.

MR. SWEATLAND: The object of this work has been previously set forth in a plain and comprehensive manner, but it may be briefly alluded to here not only to emphasize its importance but to enlist the earnest co-operation of the members of this association. The committee has undertaken to record the actual cost in tons of coal of a definite amount of horse power actually delivered, *i. e.*: work actually performed represented by amount of electric current actually delivered, recording the results obtained from all ordinary types of equipment in use for the generation of power, more especially steam power, the idea being to show not only the difference between the results obtained from the more modern and complete installations and those less favored in equipment, but to record the varying results obtained from each special type of equipment under different management, making the comparison of coal with coal, boiler with boiler, engine with engine, type with type and appliance with appliance.

These records will enable the manager of an electric plant having an ordinary equipment to compare his results with those plants operated under exactly similar conditions. To this end an inquiry circular was sent to all the central stations in the United States.

The questions asked for different data; first as to equipment and second for information regarding the time and amount of fuel required to generate a definite amount of horse power.

The call has been responded to liberally by the different companies, something over four hundred returns having been received up to date, from which the foundation of this work has been fairly started, and the compilation of data received has been commenced

Arrangements have also been made to obtain data relative to the economic generation of power in other branches of manufacturing. Results obtained in the engine room of the cotton mill, the rolling mill and various other industries, together with their special equipment, will be recorded for the benefit of comparison with the results obtained from similar equipments in electric lighting. Five hundred circulars to leading manufacturers have brought out a ready response, and we must confess these returns show an elaboration of detail and a conciseness of calculation which prove that the question of economy in the generation of power is not a new one to manufacturers.

The returns from the central stations are the best evidence that could be offered as argument in favor of this work, for while many of the returns are complete, proving that a faithful record of the cost of the required power is at the disposal of the manager, a larger number of them report no tests made or no records kept, and in several instances the whole quota of questions was answered by the very expressive and comprehensive statement "Never mind the cost of power, we are paying dividends." Those sending complete reports often accompanied the returns with a letter of inquiry as to what others were doing with a similar equipment; expressing marked interest in the work of the committee and asking for a copy of the report when completed, and we predict that future reports from a "no datum but dividend-paying" element of these returns will in the near future withdraw their statement regarding dividends, and report themselves as doing less business or out of business, having failed to meet successfully the competition of the manager who knows what power costs and sells electric current at a fair margin of profit on that basis.

In a very few instances only were all the questions in the circular answered. The evaporation of water per pound of coal was stated in only 21 reports. In a less number of instances was the percentage of entrained water stated, and the question relating to the number of pounds of steam used per horse power was often considered altogether too intricate and far reaching.

Now, while answers to these questions are imperative to successfully compare appliance with appliance, all those reports which gave work performed and fuel actually consumed were useful, and formed a basis of a good beginning. The main idea of the inquiry circular was, however, often lost sight of or ignored, and the question of the amount of coal used or its reciprocal question relative to the work performed left unanswered, while nearly all the others were answered in full. However, as has been stated, sufficient data have been received to furnish the foundation of this work, and more than enough to satisfy the most skeptical of the absolute necessity of these records.

If the business of electric lighting is to be successfully conducted, a fair basis of first cost of power must be made the basis of charge for the service rendered, and if 1-horse power can be generated for one hour by burning one and one half pounds of coal the consumer of electric light will not long be satisfied to pay a profit to that electric light plant whose management is satisfied to burn ten pounds of fuel for this same horse power.

The reports received in many instances show evident haste in preparation, but as received they convey a record of expenditure for fuel varying to the extreme mentioned above. A large number of plants are reported as burning from eight to ten pounds of coal per horse power per hour; very few even with the modern equipment of higher expansion and condensing engines were able to show a record below three pounds of coal per horse power, while other equipments of the same class report an equivalent duty with one half of the expenditure of fuel.

As the inquiry circulars have only been in the hands

No.	Name.	Fuel.	Feed water.	Purity.	Boiler.	Evaporation.	Engines.	Steam per H. P.	Speed.	Load.	Average H. P.	Hours per day.	Lights, arc.	Delivered incandescent.	Fuel per day.	Coal per hour per H. P.
1	Mendota	Soft.	190°	Pure.	Hor. Tub.	7	Aut. non-cond	35	240	2/3	66	12	25	650	4,000	5
2	Baker Mfg. Co	Soft.	200°	B. C.	Hor. Tub.	...	Aut. non-cond.	...	200	Medium.	38	5½	Full 70	325	1,000	4.8
3	Badger	Soft.	212°	B. C.	Hor. Tub.	...	Aut. non cond.	32	250	Full.	150	15	Half 60	2,600	1,100	4
4	Burlington	Soft.	150°	B. C.	Hor. Tub.	...	Aut. non-cond.	...	212	Full.	30	6½	2	350	600	30
5	Golden	Slack.	196°	Super-h't'd steam.	Hor. Tub.	...	Aut. non-cond.	...	300	50%	60	12	22	800	4,000	6½
6	Edison	Soft.	200°	73%	Hor. Tub.	...	Aut. non-cond.	...	250	73%	85	15	62	2,200	9,000	7
7	Uniontown	Slack.	205°	Pure.	Hor. Tub.	...	Aut. non-cond.	...	525	Full.	93	24	.....	1,300	7,500	3½
8	East Albany	Heater.	200°	B. C.	Hor. Tub	...	Aut. non-cond.	...	300	2/3	40	14	.....	200	...	...
9	Ocean Grove	Pea.	200°	B. C.	Hor. Tub.	9	Corliss non-cond.	29	85	85%	292	6	120	903	1,600	3.3
10	Brush	Hard.	Heater.	B. C.	Hor. Tub.	....	Aut. non-cond	...	300	Full.	110	7	.....	60	3,000	3.6
11	Bristol	Pea.	150°	Pure.	Hor. Tub.	...	Aut. non-cond	...	350	Full.	...	16	Half 49	1,100	3,800	5
12	Eastport	Soft	190°	Soda	Hor. Tub.	8	Aut. non-cond.	25	220	75%	60	6	22	600	2,246	3½
13	Norfolk	Slack.	Heater.	Coal oil.	Hor. Tub.	...	Triple expan-son.	...	365	Full.	60	14½	35	350	10,800	10
14	Middle St., New Bedford	Soft.	200°	Pure.	Hor. Tub.	...	Aut. non-cond.	...	247	Full.	135	24	Full 190	8,200	16,000	5
15	New Bedford	Pea.	210°	Pure	Hor. Tub.	...	Aut. non-cond.	...	334	.....	6,855	24	Half 190	5,653	20,565	3
16	Walla Walla	Coal and wood.	Heater.	Pure.	Hor. Tub	...	Comp. cond	...	280	60%	...	14	.....	800	3,000	...
17	Easton	.....	200°	B. C.	Hor. Tub.	...	Aut. non-cond	...	...	.....	.....	24	130	5,600	14,000	...
18	Sandy Hill	Pea.	90°	Slippery Elm.	Hor. Tub	...	Aut. non-cond.	...	282	Full.	60	8	50	500	2,500	6
19	Martinsburg	Soft.	130°	Blowing.	Hor. Tub	..	Aut. cond	110	270	Full.	70	16	30	1,200	3,000	4
20	Charlottesville	Soft.	Heater.	Pure.	Hor. Tub.	...	Aut. non-cond.	...	310	Full.	.....	12	Half 25	900	6,000	...
21	Gloversville	.....	120°	B. C.	Hor. Tub.	....	Aut cond.	...	174	Full.	140	18½	120	700	6,000	2½
22	Sturgis	Soft.	225°	B. C.	Hor. tub.	...	Aut. non-cond.	...	300	3/4	45	10	6	750	1,640	4
23	Southbridge	Soft.	Heater.	Pure.	Hor. tub.	..	Aut. non cond.	...	260	Full.	...	7	90	500	3,500	...
24	Gardner	Soft.	160°	Pure.	Hor. tub.	.	Aut cond.	...	134	Full.	100	13	Half 72	2,200	3,500	3
25	Clinton	Soft.	Heater.	Some scale.	Hor. tub.	....	Aut. non-cond.	...	150	.....	50	6	Half 60	400	1,400	4½
26	Freebold	Pea.	198°	Soda ash.	Hor. tub.	..	Aut. non-cond.	80	270	Full.	30	5	.....	450	1,000	6½
27	Wyoming	Soft and slack.	200°	Pure.	Hor. tub.	8½	Aut. non cond.	...	334	.....	34	12	.....	2,000	3,000	4½
28	Glens Falls	Soft and coke.	Heater.	Pure.	Hor. tub.	..	Aut. non-cond.	...	285	Full.	.....	8	100	85	1,000	...
29	Waukesha	Soft.	Heater.	Kerosene.	Hor. tub	..	Aut non-cond.	...	152	3/4	...	7	.....	800	2,700	...
30	Queen City	Dust.	Injector	B. C.	Hor. tub.		Automatic.	..	150	Full.	.....	13	40	500	8,000	...
31	Cedar Falls	Slack.	Escape steam.	.....	Hor. tub.		Automatic.	...	200	Full.	...	12	29	250	6,000	...
32	T-H	Slack.	210°	B. C.	Hor. tub.	5	Automatic.	...	205	3/4	...	15	13	700	13,000	8
33	Springside	Slack.	Cold.	Oil	Hor. tub.	.	Automatic.	.	275	Full.	50	14	.....	650	8,000	12
34	Alton	Coal.	Heater.	B. C.	Hor. tub.	.	Aut. non-cond.	.	250	Full.	55	6	46	...	...	3.91
35	Mattoon	Slack.	180	Pure.	Hor. tub.	.	Aut. non cond	...	220	3/4	.....	13	80	650	8,000	...
36	Nevada	Nut.	Heater.	Pure.	Hor. tub.	.	Aut. non-cond.	...	285	3/4	..	13	75	..	5,000	...
37	Horne	.....	Heater.	Soda	Hor. tub.	.	Automatic.	.	280	Full.	50	7	15	...	9,000	5
38	Renovo	.....	Heater	Coal oil	Hor. tub.	.	Aut. non-cond.	..	290	.....	70	13½	.....	1,250	4,000	4
39	Murfreesboro	R. M. coal.	100°	Pure	Hor. tub.	.	Aut. non cond.	...	190	3/4	100	13	.....	1,500	3,000	3
40	Ballston	Pea	Heater	Pure.	Hor. tub.	.	Aut cond	...	300	Full.	...	16	.....	750	2,600	...
41	Salem	Crumb and brick.	185	Soda ash.	Hor. tub.	9	Aut cond	...	290	3/4	...	24	300	2,600	32,000	2.10
42	Brush, Columbus	.....	210°	Pure	Hor. tub.	9½	Aut cond	.	128	Full.	200	13	121	1,521	5,700	2.10
43	Creston	Slack.	200	Pure	Hor. tub.		Automatic	..	275	1/2	54	7½	.....	500	3,000	8
44	Carbon	Pea and coke.	Almost boiling.	Pure.	Hor. tub.		Aut. con cond.	.	375	26 H. P.	26	8	30	...	1,000	5
45	Grafton	Wood.	170	Pure	Hor. tub.	.	Aut. cond.	.	350	Full.	...	7	.....	500	150 c.	...
46	Burlington, Kansas	Many kinds.	165°	Scale: no remedy.	Hor. tub.		All	.	210	1/2	18	6½	15	50	...	...
47	Rockford	Hi lump.	212°	B. C.	Hor. tub	8	Aut. non cond.	...	...	...	.	24	100	7,000	...	...
48	.....	Wood.	212	Pure.	Hor. tub.		Aut. non-cond	..	265	...	..	...	.....	..	...	...
49	Superior	Soft lack.	161°	Pure	Hor. tub	8 12	Aut. cond.	17	372	3/4	...	21	214	1,800	...	...
50	Antigo	Wood.	200	Pure.	Hor. tub.		Aut. non-cond.	34	285	Full.	40	12	.....	1,600	4 cords	3lb.
51	Tyler	Hard wood.	190°	Pure.	Hor. tub		Aut. non cond	...	275	70%	80	14½	.....	1,400	3/4 "	...
52	Bedford	.....	Nearly boiling.	Pure.	Hor. tub		Aut cond	.	325	1/2	40	14	.....	...	3,000	6
53	Post Carbon	Pea.	Heater.	Pure	Hor. tub.		Aut non cond.	.	205	...	52	14	.....	491	2,100	5
54	Carroll	Pea.	210°	B. C	Hor tub.		Aut non cond.	.	185	Full.	...	18	.....	900	6,000	...

COMPARISON OF ECONOMY IN THE GENERATION OF POWER.—TABLE CONTINUED ON PAGE 126.

the different companies a few days, a large percentage of them have not yet reached the hands of the committee. It has been impossible in this short space of time to issue a complete report in time for this convention. If the work can be continued until the next convention the committee feel confident of being able to place in the hands of the members of this association a report which will be of special value.

Annexed is a tabulated summary of the reports received.

WORLD'S COLUMBIAN EXPOSITION.

THE PRESIDENT: The report of the Committee on the World's Columbian Fair of which I am chairman is next in order. I will report that I have notified Director General Davis of Chicago of the appointment of this committee and of its willingness to co-operate with him in a way to secure the success of the exhibits. I received a reply that my invitation had been received and placed on file and at the proper time would be answered by the proper person.

The report was received and the committee continued.

AFTERNOON SESSION.

The following officers were elected for the ensuing term.

President: C. R. Huntley, Buffalo, N. Y.
First Vice President, James I. Ayer, St. Louis, Mo.
Second Vice-President, M. J. Francisco, Rutland, Vt.

THE PRESIDENT: It gives me great pleasure to present one of the four names that stand high in the annals of American inventors—one of the first to enter the field of electricity. Yesterday we had with us Thonson; to-day Weston. The other two Brush and Edison, have honored us either by letters that show conclusively that they were interested in our proceedings. There is no word that I could use that would introduce him to you more fully and completely than to simply call the name of the gentlemen, Edward Weston, of Newark, New Jersey.

MR. WESTON: The president has requested me to make a few remarks, gentlemen, in regard to electric measuring instruments and their methods of use and care. A few years ago such a thing would have seemed to me almost impossible. In 1881 to 1882 a proposition to place a voltmeter of excellence, or an ammeter of excellence on every plant, or in connection with every dynamo, as was suggested here to-day by Mr. Smith, would have been met, I think, very largely with ridicule. That was not the fault of the users as much as it was, probably, of the people who were engaged in pushing forward the commercial end of the business. I was greatly pleased to day with the paper of Mr. Smith. It embodied so many excellent suggestions in regard to the care of plants, the exact means of finding out where difficulties arise, of locating them instantly, and removing them quickly. Almost every serious fire that has occurred in an electric lighting station has owed its origin and done most of its mischief through the agency of the switch-board. I have had occasion to examine quite a number of the results of such fires, and I have almost always traced it back to their switch-board where there was an amount of inflammable material collected which was bound so give rise to some serious trouble. That is nearly wiped out. Wooden constructions are rapidly disappearing. Dangerous insulating materials likely to carry fire from one section of a building to another are being given up. The question of insulation is of less importance inside the station than the question of safety from fire. Compared with the early stages of the art it was indeed gratifying to me to find that these things had gradually become recognized as a necessity. In regard to instruments I would say this—almost every instrument has its peculiarity. They must all be used properly, and every one of them must be used under certain conditions in order to yield certain and accurate results. The voltmeter of the Cardew type, which is supposed to be a very permanent form of voltmeter for use with alternating or direct currents is so extremely sensitive to changes in temperature from external sources as to make quite a perceptible error, and one which would in the end cause a station considerable loss. If any one would like to satisfy himself about that let him place such an instrument in circuit near a window through which the sun is shining, shield it from the sun's rays, turn the current on, observing the reading. Let the sun's rays fall on the tube and notice the change. I think most of you will be considerably surprised to find that the percentage of change is very large, even under those conditions The Cardew instrument properly used will yield excellent results. It should not, of course, if accurate readings are desired, be placed in a vertical position. The index moves too much, and I believe you all fully realize the fact that a volt or two volts additional on an incandescent lamp enormously shortens its lifetime besides adding largely to the coal bills. In direct current instruments it will be supposed by many persons that because many contain no permanent magnet that their readings are not affected by their proximity to a dynamo. Do not believe it. It is not so. It is a very easy matter to ascertain how much their readings are affected under different conditions, but you will find that they are very seriously affected, and in general no instrument that is being used for the purpose of making an accurate determination should be placed near any disturbing force, either conductors carrying powerful currents or other magnetic fields. That should be strictly avoided. The Cardew is less affected in that respect than some others, but it is not entirely free from that difficulty either. Those instruments that are least affected are instruments of the zero type. That is to say where you balance a known electromotive force against the unknown electromotive force by means of a rheostat. These are less liable to be affected than any of the so-called direct reading instruments. But they also are affected—their sensibility is reduced. In making readings they should never be placed very near dynamos. Permanent magnet types of instruments which have certain very desirable qualities for general use in direct current measurements should never be taken very close to dynamos. If the magnets are properly made and the magnetic construction is good you may trust permanent magnet instruments implicitly for years, supposing they are used with care. The most careful examination has revealed the fact that after three years' continuous use the change amounted to less than one-tenth of one per cent. Now how is that secured and how is it maintained? It is secured in the first place by very careful selection of the steel and very careful artificial etching and also in the design of the instrument. Those three things came into play there. After they leave the instrument maker's hands they sometimes get pretty badly abused. People are not very apt to think how much labor has been spent in making those instruments. They should not be used roughly by any means. They should be carried with extreme care, and should not be very much jarred, because jarring, while it does not affect the magnet at all, is likely to damage the pivots or jewels which carry the moving parts, and so introduce the element of friction The element of friction is a very serious thing in a very large number of instruments. In some the error will amount to three or four per cent. In others it is much less. In voltmeters there is another source of error which should be looked after, particularly in some forms of instrument. Voltmeters whose coils are wound with copper, unless they have compensators or some device for compensating for the change in the temperature of the copper are not reliable instruments to use for station work. It is commonly known, of course, that the co-efficient of error of temperature as it is commonly called, is very large for copper. It amounts to about one per cent. for every five degrees Fahrenheit. Therefore a change of twenty degrees introduces an error in such instruments of about four per cent.; a larger change, of course, introduces an error correspondingly greater. German silver does that to a less degree of course. But even there there are serious difficulties to be met in getting an instrument which at the same time that the temperature co-efficient is low, will not heat too much by the passage of the current. So that no instrument should be sent out as a standard voltmeter, or as a voltmeter to check other voltmeters without an absolute statement of its temperature error, and some means of providing for its ascertainment. It does not suffice to notice the

55	Woburn	Soft.	110°	Pure.	Hor. tub.	9	Aut. non-cond.	.....	265	Full	.....	16	Full 88 / Half 44	2,174	12,000	...
56	Piedmont	Coal.	.....	B. C.	Hor. tub.	....	Throttle non-cond.	.....	330	Full	.....	13½	22	700	4,000	...
57	Newberg	Pea.	197°	Pure.	Hor. tub.	7	Aut. non-cond.	.....	220	Full	.....	15	Half 210	2,100	15,000	...
58	Carlisle	Soft.	212°	Pure.	Hor. tub.	....	Automatic.	.....	200	.....	125	13	112	1,300	1,500	3
59	Melville	Soft.	212°	Pure.	Hor. tub.	....	Aut. non-cond.	.....	302	Full	.....	9	Half 93	36	1,750	...
60	Kingman	Slack.	150°	Pure.	Hor. tub.	....	Aut. non-cond.	.....	225	Full	.....	7	24	140	2,500	...
61	Granville	Nut slack.	180°	B. C.	Hor. tub.	....	Aut. non-cond.	.....	245	¾	165	14	74	1,600	10,000	4½
62	Beatrice	Nut slack.	160°	Kerosene.	Hor. tub.	....	Aut. non-cond.	.....	102	Full	65	12	40	750	6,000	5½
63	Cedar Rapids	Nut slack.	180°	Scale; no remedy.	Hor. tub.	5	Aut. non-cond.	.35	240	Full	95	16	65	3,315	14,869	10
64	Reidsville	Pocahontas.	200°	Kerosene.	Hor. tub.	....	Aut. non-cond.	.....	250	¾	30	13½	Full 20 / Half 18	125	3,300	5
65	Rockfort	Slack.	Coil.	Pure.	Hor. tub.	....	Ball comp.	.....	296	½	.....	6½	.....	400	15,000	...
66	Canastota	Soft.	150°	Pure.	Hor. tub.	6	Aut. cond.	30	206	Full	90	12	43	1,000	4,200	6
67	Citizens'	Soft.	190°	B. C.	Hor. tub.	....	Aut. cond.	.....	276	¾	.....	6	31	265	3,000	...
68	Washington	Soft, coke.	112°	Heater.	Hor. tub.	....	Automatic.	.....	260	Full	.....	9	Half 89	.....	2,250	...
69	Evanston	Slack.	150°	B. C.	Hor. tub.	10	Aut. non-cond.	.....	275	Full	.....	12	.....	1,200	8,000	...
70	Merchants'	Ind. block.	216°	B. C.	Hor. tub.	10	Aut. non-cond.	.....	260	¾	95	10	Full 40 / Half 60	.....	4,000	5
71	Hirkerson	.....	185°	B. C.	Hor. tub.	....	Aut. non-cond.	.....	240	⅞	38	16½	300	300	1,600	4½
72	Poughkeepsie	Pea	205°	B. C.	Hor. tub.	....	Aut. non-cond.	.....	285	Full	.....	14⅛	Full 187 / Half 113	1,350	14,200	...
73	Mt. Holly	Pea.	204°	Pure.	Hor. tub.	....	Aut. non-cond.	.....	320	¾	.....	13	.....	1,050	3,500	...
74	Gainesville	Soft.	212°	B. C.	Hor. tub.	....	Aut. non-cond.	.....	287	½	.....	12	40	300	6,000	7½
75	Consumer	Coal	208°	B. C.	Hor. tub.	....	Aut. non-cond.	.....	225	Full	100	6½	120	.....	3,000	5
76	Independent	Slack.	212°	Pure	Hor. tub.	....	Throttle non-cond.	.....	350	Full	35	7½	.....	500	2,500	4.8
77	Lackawanna	Culm.	212°	Pure	Upright.	....	Automatic.	.....	385	Full	40	20	.....	450	4,000	5
78	Revenna	Nut.	190°	Pure.	Hor. tub.	....	Aut. non-cond.	.....	250	Full	50	7	51	.....	2,140	6
79	Waterloo	Slack.	50°	Pure.	Hor. tub.	5	Aut. cond.	90	270	⅔	90	8	67	500	6,000	6
80	Concord	Soft and scre'n'gs	200°	Pure.	Loco.	....	Aut. non-cond.	.....	180	½	.....	6	Half 195	.....	4,000	...
81	Laramie	Soft slack.	189°	Pet.	Hor. tub.	8½	Aut. non-cond.	.....	270	½	200	12	175	3,065	10 000	7½
82	Naugatuck	Soft.	Heater.	Pure.	Hor. tub.	....	Aut. non-cond.	.....	280	Full	60	7	Half 15	500	1,500	6
83	Manitowoc	Wood.	112°	Pure.	Hor. tub.	....	Corliss cond.	.....	80	.....	40	12	.....	3,000	4,000	5
84	Whitewater	Coal.	212°	Pure.	Har. tub.	....	Aut. non-cond.	.....	130	Full	125	9	34	640	.....	...
85	Pella	Slack, nut. pea.	210°	Potatoes.	Hor. tub.	....	Aut. non-cond.	.....	143	½	.....	6	.....	450	1,750	...
86	Greenview	Slack.	80°	Coil oil.	Shell.	....	Aut. non-cond.	.....	300	⅓	.....	6	.....	120	20,000	2.75
87	Chicago	Indiana.	135°	B. C.	Hor. tub.	7½	Aut. cond.	17	136	Full	750	24	Full 1,500 / Half 280	1,300	70,000	3.8
88	Utica	Soft.	200°	B. C.	Hor. tub.	....	Aut. cond. / Aut. non-cond.	.....	132	Full	.....	24	460	3,000	20,000	...
89	Osceola Mills	Slack.	175°	Chan.	Hor. tub.	....	Aut. non-cond.	.....	275	Full	68	14	.....	1,200	6,000	6½
90	Sycamore	Coal.	205°	B. C.	Hor. tub.	....	Aut. non-cond.	.30	266	½	43	5	23	200	1,500	7
91	Northern	Pea.	210°	B. C.	Hor. tub.	9	Aut. non-cond.	.27	135	Full	750	16	600	800	30,000	3
92	Oakland	Domestic	91°	Pure.	Hor. tub.	5.9	Aut. cond.	17½	85	⅞	470	8	.....	.....	.....	3½
93	Passaic	Pea.	200°	Kerosene.	Hor. tub.	...	Aut. cond.	.....	235	Full.	130	24	70	2,000	14,000	5
94	Beaver Dam	Soft.	150°	Black oil.	Hor. tub.	10 9	Aut. non-cond.	.....	300	Full.	.....	7	.....	1,000	4,000	...
95	New Lisbon	Soft.	200°	Filter.	Hor. tub.	....	Aut. non-cond.	60	180	⅝	60	11	40	450	1,750	3½
96	Camden	Pea.	190°	Pure.	Hor. tub.	.12	Aut. non-cond.	.50	215	Full.	350	16	330	1,300	25,000	4
97	Cambridgeport	Soft.	203°	B. C.	Hor. tub.	....	Aut. cond.	.....	225	Varies.	.....	24	Full 133 / Half 51	5,000	40,000	...
98	Oneonta	Soft.	Heater.	Pure.	Hor. tub.	....	Aut. non-cond.	.....	320	Full.	.....	14	40	900	6,500	...
99	Laconia	Wood.	Heater.	Pure	Hor. tub.	....	Aut. non-cond.	.....	120	.....	150	2	93	750	.....	...

NON-ELECTRIC COMPANIES.

1	American Linen Co.	Soft.	210°	Pure.	Hor. tub.	Varies	Aut. cond.	.....	100	Varies.	.....	10	.....	.....	.....	...
2	Yonkers Hat Co.	Pea dust.	170°	.....	Hor. tub.	....	Throttle non-cond.	.....	63	Full.	.....	10	.....	.....	10,000	...
3	Yale Towne	Pea dust slack.	212°	Pure.	Hor tub.	6.41	Corliss.	3.6	72	⅛	170	10	.....	.....	15,680	...
4	Hecks-Brown	Pea.	200°	Purifier.	Water tube.	....	Harris-Corliss.	.....	70	Full.	.....	24	.....	44	12,000	...
5	Crescent	Hard, soft.	199°	Pure.	Hor. tub.	9.14	Aut. part. cond.	26.69	54	⅜	700	10	.....	.....	19,800	1 92
6	Fitchburg	Soft gleanings.	150°	Pure.	Hor. tub.	....	Aut. cond.	.....	125	⅜	35	15	.....	.....	1,000	2½
7	Plymouth Cordage	Pea dust.	157°	Pure.	Hor. tub	8¾	Aut. cond	14½	55⅝	Full.	1,140	10	.....	.....	30,000	1.9
8	J. I. Case	Coal savings.	212°	B. C	Hor. tub.	8½	Corliss cond.	20	68	⅛	220	10	12	.....	.....	...
9	Eagle Power Co.	Nut slack.	200°	Scale; no remedy.	Upright tub.	13	Corliss aut.	.....	50	⅜	.....	10	.....	.....	10,500	3⅝

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Executive Committee. Class 1. E. H. Peck, Brooklyn, N. Y. John Seely, New York City, N. Y., R. Fabian, Jr., Toledo Class 2. Albert J Corriveau, Montreal; H. H. Fairbanks, Worcester; A. J. DeCamp, Philadelphia. Class 3. J. J. Burleigh, Camden; A. N. Robertson, Minneapolis; E. W. Rollins, Denver.

The recommendation of the executive committee of whole that the next meeting be held in Montreal in the month of August was adopted, and the executive committee was instructed to arrange the date.

The following resolution offered by Mr. Shaw was adopted:

Resolved: That within thirty days of his election the incoming president shall appoint a committee of three active members of the association whose duty it shall be to formulate such amendments to the constitution as may be deemed necessary, and to submit their report at the next semi-annual meeting of the association; the amendments thus reported to be introduced at the semi-annual meeting and be over under the rules and be considered at the next annual meeting of this association.

The chair announced the following committee on rules to govern outside and inside wiring: Messrs. DeCamp, Barton, Brophy, Law and Smith.

The report of the committee on incandescent lamps was accepted and the committee discharged with thanks. The committee on legislation was continued.

It was agreed on motion of Dr. Mason that a committee of three on underground conduits and conductors be appointed to report at the next meeting.

Mr. Huntley speaking on the subject referred to him at the last meeting, "How can the National Electric Light Association best Serve Central Station Interests?" recommended that the advisability of having but one meeting a year be considered. He was not prepared to say that the time had arrived yet for that change, but he believed that it would soon come.

The report of the secretary and treasurer was filed.

temperature of the surrounding air, because the temperature of the coils inside the instrument may be very different from that of the surrounding air, especially after the instrument has been in circuit for a short time.

The recommendation of the executive committee to elect Mr. Weston to honorary membership, was adopted.

THE PRESIDENT: I have to thank you one and all for your uniform courtesy, your earnest and hearty sympathy and assistance which has been rendered to me all through the year. I feel it and feel it very keenly. It is very pleasant to have you oome down here and sever my official relation here at my own home. I am very glad, indeed, that you have come here and have an opportunity to inspect what I myself have been trying to accomplish in the way of advancing the electrical indutries of the country, in promoting it, putting it on a substantial footing.

The convention then adjourned *sine die*.

Convention Notes, Exhibits and Personals.

The formal opening of the exhibition of electrical apparatus in connection with the convention was one of the most interesting features of the meeting. The members and their friends assembled Tuesday evening at Union hall, where the exhibits were arranged, and they were reinforced by large delegations of residents of Providence. So great was the interest manifested in the exhibition, that large numbers of persons from the surrounding towns visited the city for the purpose of attending the opening exercises. As a result the hall was thronged almost to suffocation, but all were amply repaid by the excellent display they witnessed. Assembled on the platform in the upper end of the hall were President Perry, Chairman Barney of the committee having in charge the exhibition, W. J. Hammer who personally superintended the arrangement of the display and designed the decorations, ex-Governor Ladd, and many of the ladies who attended the convention. In the gallery at the opposite end of the hall was a large representation of the leaders of Providence's most fashionable society.

While the spectators were assembling the hall was dimly lighted by a few gas jets, making the contrast when the electric lights were turned on very striking. When the hour arrived for opening the exercises General Barney presented President Perry, who made a short address in which he thanked the committee for its labors and welcomed the visitors to the exhibition. Ex Governor Ladd was then introduced, and on behalf of the citizens of Providence he welcomed the representatives of the electrical interests and thanked them for the honor conferred upon the city by selecting it as their meeting place. He paid a graceful compliment to the members of the association and President Perry and predicted great achievements in electrical development. He referred to the electricians as a bright and pushing company of men. "For all are young men," he said; "even your veterans are young. The science of electric lighting has had a rapid growth, but the profession stands to-day the peer of the oldest and highest of the sciences or arts. We are all much interested in electric lighting in this city. We believe we build the best engines for electric lighting here; have the model electric lighting station and have some of the smartest men in the profession in this city, a fact you have proved by choosing one of them for your president."

The formal opening of the exhibition was the next feature. General Barney said the science of electricity had been referred to as in its infancy. It was fitting, therefore, that the act of directing the current which should illuminate the exhibition should be performed by one who, by reason of her tender years, might typify the genius of electricity, and he presented Miss Bertha Leola Thomas, the five year-old daughter of Van A. Thomas, superintendent of the Narragansett Lighting company. The device used was the switch which closed the circuit for the first incandescent lamps ever run from a central station in the world. This was a station of 3,000 lights capacity at 57 Holborn Viaduct, London. Introduced into the circuit, and immediately beneath the descriptive placard, was a short piece of the first Atlantic cable laid, given to Mr. Hammer by Cyrus W. Field.

The turning on of the lights was the signal for a tremendous uproar. Hundreds of tin horns were blown, gongs were sounded and the greatest enthusiasm prevailed. When at last the visitors turned their attention to the display they were filled with amazement. The scene presented was indescribable. The exhibits had been arranged with excellent taste and the decorations were beautiful. Some idea of the scene can be gathered from the view of the exhibits presented in the illustration on page 102, but the beautiful effects of the electric lighting defy reproduction. Immediately in front of the entrance was the Narragansett Electric Lighting company's handsome display of incandescent lights arranged so as to form the letters "N. E. L. Co." Beneath these lights were arranged copies of the WESTERN ELECTRICIAN containing illustrations of the company's station. There was a great demand for these papers, and every visitor to the exposition seemed to make it a point to procure a copy.

H. A. Rogers' railway and machinists' supplies were exhibited.

J. H. Shay of Chicago was on hand to boom the Munson Belting company.

There were sixty-five central station men in attendance, an unusually large number.

The convention was undoubtedly the most successful in the history of the organization.

C. S. Van Nuis of New York had something new in the way of "Ajax" lightning arresters. Mr. Van Nuis explained the operation of the device, which has many advantages to commend it.

The Star Electrix company of Philadelphia showed the various styles of its Electrix switch.

C. A. Benton, manager of the railway department of the Detroit Electrical Works, attended the convention.

The Fishkill Corliss Engine company was represented, and the excellent features of its machines detailed.

The Holtzer-Cabot Electric company of Boston, displayed its pressure indicator and automatic pressure controller.

Louis R. Wallis, Boston, looked after the interests of the Buckeye Electric company for which he is New England agent.

W. D. Morris represented the Sawyer-Man company, and had no trouble interesting visitors in that company's specialties.

A very handsome model of the Babcock & Wilcox boiler was displayed in the upper gallery. It proved an attractive feature.

A new incandescent lamp socket, manufactured by the Insulite Manufacturing company of New York, was shown by Thos. G. Roebuck.

Pettingell Andrews & Co. of Boston, were well represented, and their space in Union hall was one of the busiest points in the exhibition.

Samples of the Standard Underground Cable company's special lines were displayed by G. L. Wiley, the eastern representative of the company.

The Illinois Electric Material company was represented by E. L. Clark of Chicago, who explained the specialties which his company is exploiting.

The Washburn & Moen company's display was one of the neatest and most attractive in the hall Conductors of all sizes were tastefully arranged in neat cases.

E. F. Gennert, superintendent of the E P. Gleason Manufacturing company, New York, and J. C. Ryan of the Gleason & Bailey company, Chicago, were present.

Charles E. Gregory of Chicago represented the Sperry company. He showed an arc lamp, motor and several other devices of the well-known Sperry type at Union hall.

Frank P. Wisner represented the Consolidated Fruit Jar company of New York. Mr. Wisner was rewarded for his labors at the exhibition by securing several fine orders.

C. R. Huntley, the newly elected president, shared the honors of the evening with his predecessor and President Phillips at the house-warming of the American Electrical Works.

The Eureka Tempered Copper company of North East, Pa., showed samples of pure tempered copper in its numerous specialties, including commutators, brushes, rolled goods and copper castings.

The Western Electric company was well represented. Chas. A. Brown and John Young, of the Chicago office, Fred Wilkins and J. George Kaelber of the New York house, were in attendance.

Benj. R. Western, of the Manufacturers' Advertising Bureau, New York City, ever watchful of the interests of his clients, was in attendance and represented several electrical concerns. They were well cared for.

The Munsie Coles Subway company, New York, was represented by Thomas A. Coles, Jr. This company makes a specialty of underground street car circuits, and does all kinds of interior and underground wiring.

E. M. Carhart & Co. of Providence, called attention to several specialties illustrated in the last issue of the WESTERN ELECTRICIAN, including a mast arm, tree insulator, carbon holder, pole steps and cable clip.

H. A. Cleverly personally represented his establishment and, as usual, had a novelty to present to visitors. A unique glass paper weight and calendar combined will remind the delegates of the Cleverly Electrical Works of Philadelphia,

Holmes, Booth & Haydens, manufacturers of bare and insulated wires, New York, were represented by Theo. Larbig, who has the distinction of being the veteran among veterans in this line. The firm had an attractive exhibit.

Myron A. Knapp of the Knapp Electrical Works, Chicago, was present. The Perkins Electric company and the Perkins Lamp company, for which Mr. Knapp has the exclusive Western agency, had a handsome display in the Narragansett hotel parlors.

One of the most interesting exhibits in the hall was made by the E. S. Greeley company of New York. A full line of this company's specialties was shown, and they attracted the attention not only of experts, who recognized their value, but of visitors who knew nothing of the uses to which they were adapted. The excellent workmanship and finish in the company's testing instruments attracted universal admiration.

The Electrical Merchandise company of Chicago made a small but interesting exhibit in Parlor 1, Narragansett hotel. Prominent among the novelties shown was the new Brewster trolley clamp, which was illustrated in a recent issue of the WESERN ELRCTRICIAN. This attracted much attention, principally on account of its simplicity. Samples of the rawhide pinions, of which this company makes a specialty, were also shown, besides other devices in the line of street railway supplies. The new catalogue of this company was distributed among those interested in this line. The company was ably represented by the manager, W. R. Mason, who was assisted by the company's traveling representative, D. B Dean.

The Standard Paint company, New York, presented a neat display of the P. & B. specialties—tape, insulating paint, etc., and Messrs. Shainwald and Castle were on hand to enlighten visitors on the excellent qualities those specialties possessed.

The Simplex Electric company of Boston was represented by Dr. Mason and Major Evarts. George Cutter, Chicago, who has the Western agency for this company's wires, was also present. Mr. Cutter took occasion to explain the excellent features of the numerous devices he has placed on the market.

Neat pocket cases, containing samples of valve, engine and dynamo oils, were distributed by the A. W. Harris Oil company, Providence. This company supplies all the oil used at the Narragansett Electric Light company's station, the American Electrical Works, and the New England Butt company.

Two Crocker-Wheeler motors were shown in the Narragansett hotel rotunda by Mr. LaRue, who represented the company. These motors were operated throughout the session of the convention and they made a good impression on the delegates. S. S. Wheeler was also present.

The Jewell Belting company had a conspicuous display which received much attention. The company was represented by E. L. Graves, C. L. Cole, Chas. E. Newton, Charles A. Jewell and J. W. Fitzpatrick. A feature of the exhibit was an immense belt, said to be the heaviest in the world.

The handsome instruments displayed by the Walker Electric company attracted much attention. This company's line includes ammeters, voltmeters, recording ammeters and recording voltmeters. The distinctive features claimed for these instruments are the few parts and consequent simplicity, durability and accuracy.

Thomson-Houston apparatus was seen in all parts of the exhibition hall. The company had several representatives present, and Prof. Thomson and Mr. Rice both attended the convention daily. In the exhibits of the company there were many of its well-known devices. The Thomson recording watt meter was shown and fully explained.

The newspaper delegation was one of the largest in attendance, and was certainly the largest that has attended any convention. There were twenty-two trade papers represented in addition to the local and Boston daily papers. This may be taken as another indication of extent to which electricity is finding its way into all departments of human activity.

Two Connecticut motors in operation were displayed in a show window on one of the principal business thoroughfares in Providence, and attracted much attention. The window was draped attractively and in the evening was brilliantly illuminated by incandescent lamps, so that the excellent features of the machine could be examined at all times.

One of the most important personages in the hall was the colored boy who assisted at the display of the Crosby Electric company. He was attired in a handsome uniform and dispensed his favors with discrimination and dignity. The Crosby company displayed a fine line of its well-known batteries, of which its representative, Louis Walsh, explained the special features to visitors.

Charles A. Shieren & Co., manufacturers of oak leather belting and tan leather, had an attractive display. This company showed samples of belting similar to that shipped the Louisiana Electric company recently—72 and 48 inch belts. Ths company announces that it has received the second order from the Louisiana company for a 72-inch belt. E. P. Atkinson represented the company.

Nearly every member of the association, who attended the Providence convention, visited the American Electrical Works, and partook of Mr. Phillips' hospitality. His courteous treatment of all was the subject of many complimentary remarks. At the exhibition hall the display of specialties by this company was handsomely arranged, and the features were explained by Messrs. Ackerman, Sawyer, Hathaway, Remington, Wangsell and Capper, who represented the company at the hall.

One of the most elaborate displays in the hall was that of Alexander, Barney & Chapin of New York. This company had its numerous specialties tastefully arranged on the platform opposite the entrance. An arch containing 63 incandescent lamps formed a handsome frame for this display. Under the middle arch were displayed two handsome arc lamps operated on incandescent circuits. An interesting feature of the exhibit was the display of lamps and electrical devices made in the experimental stages.

F. S. Terry and Charles Wirt represented the Electrical Supply company of Chicago. They had an excellent display of their specialties, and showed many fine measuring instruments. The numerous devices illustrated in the WESTERN ELECTRICIAN by the company were shown. They of course attracted much attention, more particularly from experts, who were interested in these specialties. Mr. Terry, who was one of the organizers of the association, said he considered the Providence convention the superior in many respects to all former meetings.

Drake, Payson & Whittier, Providence, the Rhode Island agents for the Eddy motors, the Loomis system of lighting, the Jewell Belting company and the Flexible Conduit company of Boston, had one of the largest exhibits

on the main floor. They had two dynamos in operation, each run by a 10-horse power Eddy motor. The Eddy company was represented by A. D. Newton and M. E. Baird of the Windsor office. In connection with this display the Russell Electric Manufacturing company of Providence had one side arm and one top arm fixture. On these Universal arc lamps were operated on the incandescent circuit. The lamps in the Phenix Glass company's display were furnished from the same installation.

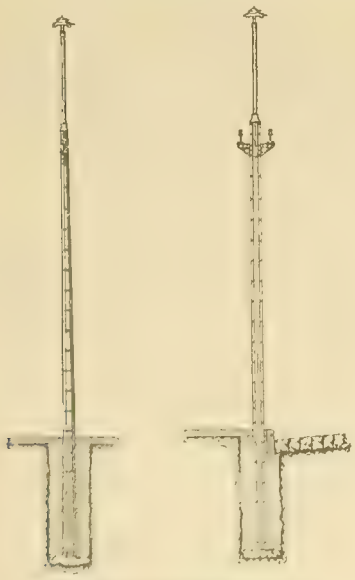
J. W. Godfrey, general manager of the New York Insulated Wire company, presided over an excellent display of his company's specialties. He announced that he would shortly place on the market a complete system of ducts for interior wiring. These tubes or ducts are to be known as vulcanoid electric wire ducts. The material, it is said, is non-inflammable, waterproof, a perfect non-conductor, pliable, smooth as glass and not affectd by extreme heat or cold or plaster. The compound and tubes are the invention of Geo. H. Meeker and the system was worked out by A. Noll, both of the company. Grimshaw white core wire was the attraction at the company's display at the convention.

The social features of the convention were the most pretentious efforts that have yet been made in this direction. The reception given by President Perry was a brilliant affair. The delegates and visitors paid their respects to the president, and complimented him upon the excellent showing he had made. Mr. Perry entertained the visitors royally.

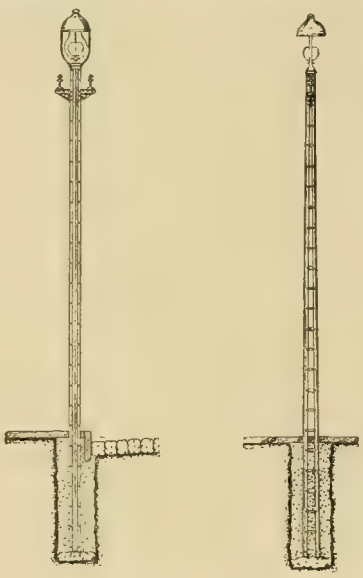
There were a number of ladies present, who added much to the enjoyment of the occasion. Many of them attended the sessions of the convention, thereby setting an excellent example to some of the members, who were not over attentive in the discharge of their duties. Among the ladies present were: Mrs. P. H. Alexander, New York; Mrs. Geo. L. Austin, Boston; Mrs. James I. Ayer, St. Louis; Mrs. Cyrus O. Baker, Jr., Newark, N. J ; Miss Stella J. Barney, New York; Miss Etta Burleigh, Camden, N. J.; Mrs. Stephen E. Barton, Boston; Mrs. Henry B. Cram, Boston; Miss Clara M. Cuming, Philadelphia; Mrs. George Cutter, Chicago; Mrs. A. J. De Camp, Philadelphia; Miss Featherstone, New York; Mrs. M. J. Francisco, Rutland; Mrs. H. K. Gilman, Chicago; Miss Evelyn Hamell, Philadelphia; Mrs. W. R. Kimball, Fort Wayne; Mrs. E. F. Peck, Brooklyn; Mrs. H. E. Paine, Dixon, Ill.; Mrs. J. B. Paine, Providence, R. I.; Miss May Robinson, Miss Hebe Robinson, Miss Belle Ridlon, Boston; Mrs. Frank Ridlon, Boston; Mrs. A. O. Shepardson, Waterbury, Conn.; Mrs. Jno. A. Seely, New York; Mrs. Fred H. Whipple, New York; Miss Weldon, New York; Mrs. Schuyler S. Wheeler, New York; Mrs. Elmer Willyoung, Philadelphia; Mrs. A. M. Young, Waterbury, Conn.; Mrs. E. P. Young, Pittsburg, Pa.; Miss Young, Pittsburg, Pa.

The Milliken Iron Electric Light Pole.

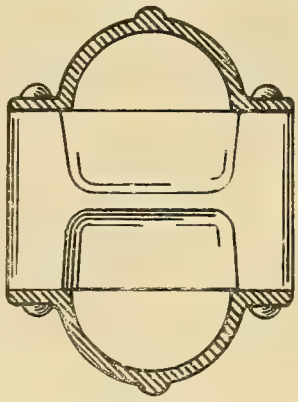
The pole shown in the cut is manufactured by Milliken Bros. of New York, and is an outgrowth of the company's street railway pole. The pole is constructed of two longitudinally flanged segments connected by rivets and gas pipe separators which vary in length and thus give the pole a taper from the ground to the top. Cast iron separators are introduced at intervals to keep the segments in line. The section of the pole shows the form of the separator. Standard incandescent light poles are arranged for the lights to be 18 feet above the street. The pole is set in the ground 5 feet. The brackets shown are arranged for two wires, although more can be used if necessary. The top of the pole is supplied with a cast iron reducer into which a 1½ gas pipe screws. The top of the gas pipe is threaded to receive a hood which carries the lights. This hood can be arranged with a reflector when necessary. When these poles are used in connection with subways a hole is cored in the cast iron separators, and the wires then pass directly up through the center of the pole. The arc light poles are similar in construction to the incandescent light poles just described, except that the pole proper runs to the base of the light. The Milliken poles have been, it is stated, extensively used in South American countries for ordinary forms of line work, such as telephone and electric light work. It has been found that in tropical countries different kinds of insects attack wood, and in a very short time entirely destroy the fibers, causing the pole to break short off at the surface of the ground. It has been found also that it is difficult to keep lines in operation where they pass through thinly settled districts, as the natives cut down wooden poles, and use them for fire-wood. These poles can be made of any length, and varying thickness according to the strain put upon them.



MILLIKEN IRON ELECTRIC LIGHT POLE.



MILLIKEN IRON ELECTRIC LIGHT POLE.

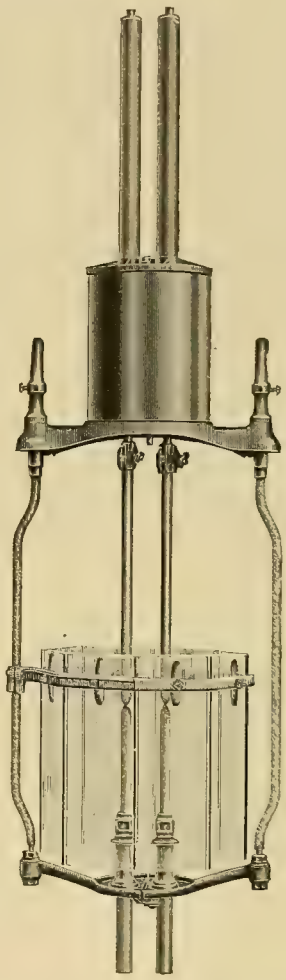


MILLIKEN IRON ELECTRIC LIGHT POLE—SECTION.

The Standard Telephone company of Chicago, has been incorporated. Capital stock, $50,000. Incorporators, W. E. Robinson, G. V. Manerth and L. A. Fish.

Gwynn Globe.

The Gwynn globe shown in the cut is composed of eight pieces of heavy French plate glass, bolted to a brass collar in such a manner as to make the breakage of the plates practically impossible. The collar in turn is fastened to one side of the lamp, as shown in the illustration.

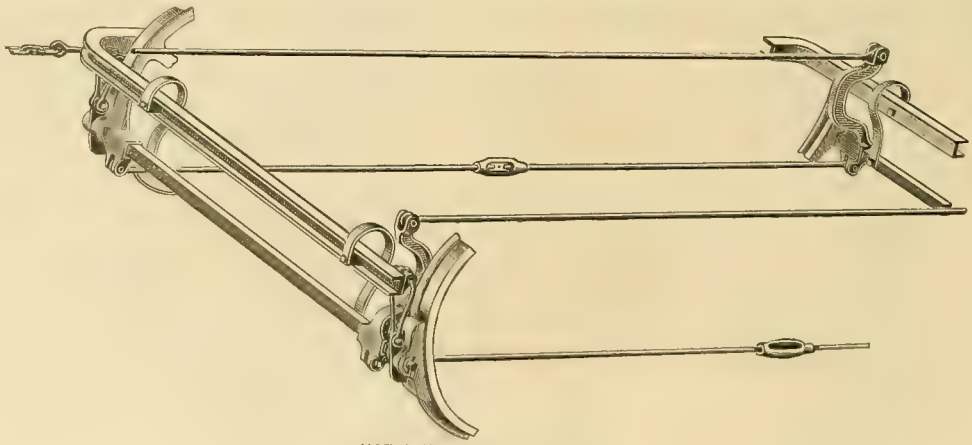


GWYNN GLOBE.

Time is saved by the fact that it is unnecessary to remove the globe to put carbon in the lamp, and the danger of breaking globes is almost entirely obviated. The globe is manufactured by the Western Electric company of Chicago, and New York.

Motor Truck and Brake.

During the past five years an immense sum of money has been invested in exploiting electrical inventions; while in the same period an equally large amount has been invested—in a manner of which the public knows but little in developing and perfecting auxiliary apparatus. In general appearance of the electric motor car is little change from the old time horse car is noted. The car body, the platforms and the wheels are apparently the same; but great al-



MOTOR TRUCK AND BRAKE.

terations and improvements have been made in the vital part of the street car—the running gear. On the old common truck it would have been almost an impossibility to have placed the present high speed electric motor, but mechanical invention has kept pace with science, and the result is a truck almost perfect in its appointments, equipped with safety brakes and other appliances for the protection and comfort of the passenger, and made throughout of the highest grade of steel bearing. The new brake, which is illustrated herewith, is just now being placed upon all trucks built by the McGuire Manufacturing company of Chicago. The principal claim made is that any one of the connections can give out or become disconnected without diminishing the effectiveness of the brake. It will be seen that this is accomplished by a double connection, yet with fewer pieces than in ordinary brakes.

CORRESPONDENCE.

Minneapolis, Minn.

MINNEAPOLIS, Minn., Feb. 21.—The board of trade of the village of Anoka has appointed a committee consisting of President Jennings, O. L. Cutter, J. H. Niles, H. Thornton and W. F. Brown to organize a stock company for the construction of an electric railway from that place into Minneapolis. Anoka is a place of several thousand inhabitants lying about ten miles north of Minneapolis on the Mississippi river, which depends upon steam railway facilities for its intercourse with this city. Its citizens have for some time been bringing all possible influences to bear on the Minneapolis Street Railway company to extend one of its lines so as to give them better connections, but they have been met with the candid explanation that local improvements and extensions would require all the energy of that corporation for some time to come. The committee of citizens above named is for the purpose of organizing a company composed exclusively of Anoka people to secure the right-of-way into Minneapolis at a point where connections are most feasible, and to construct the line. When this is done it is proposed to submit a proposition to the local company to operate it, and in the event of failure to make a satisfactory arrangement to equip it also. The project is regarded as a safe one. It will require a large expenditure, but it is believed the line would be a paying one from the start.

The Gallagher bill, reducing street railway fares to three cents, was killed in committee. At the Wednesday night session of the house judiciary committee it came up for consideration, and was indefinitely postponed. It never had any basis in public sentiment, and it is difficult to conceive how it could have been seriously considered. The McMillan bill, providing exemption from the payment of fares to those not furnished with seats, is still under consideration in committee. This is not so certain of defeat as was the Gallagher bill. The promoter of the bill is working hard to secure its passage, and he finds many among the granger legislators who are as willing as himself to castigate a corporation because it is such.

Another measure is pending of interest to the street railway corporation. The bill is not yet drawn, but it is understood that one will be introduced limiting the charge for carrying passengers between Minneapolis and St. Paul to 15 cents, with 25 cents for the round trip Such an act will include the Great Northern and the Chicago, Milwaukee & St. Paul railways, each of which now runs trains hourly all day, charging 30 cents for single fares and 50 cents for round trips. Its effect on the interurban motor line would be to increase travel largely, as the steam lines would unquestionably be compelled to abandon many trains formerly run with profit. The Milwaukee road has announced that it would make no change in its Twin City service for the present. In the meantime the electric line has cut tremendously into the business of its steam rivals, notwithstanding its still inadequate equipment

Under the auspices of the Business Men's Union a large number of citizens of Minneapolis, at a meeting called for the purpose, protested against any state legislation for the control of the street railway system of Minneapolis and St. Paul. The gathering was entirely non-political in its character. An interesting feature of this meeting was an emphatic speech against the proposed legislation, by R. J. Anderson of Anderson & Douglas, who some time ago sought to secure a street railway franchise in this city in opposition to the Lowry company.

The Minneapolis board of trade has also joined in the general uprising against the proposed street railway legislation. At a meeting called to consider it this organization appointed a committee of five citizens, irrespective of party, to wait upon the Hennepin county delegation at St. Paul, presenting resolutions which set forth that such legislation would work directly against the city's interest. The committee is composed of W. E. Steele, C. C. Taylor, Judge Atwater, J. M. Bartlett and E. J. Phelps—all prominent business men. In the meantime a circumstance has occurred in the senate which renders the defeat of the bill referred to possible, if not probable. The "combine" which has heretofore dictated legislation has been broken by serious differences in its own ranks, and it is more than likely that this and other revolutionary measures of similar character, which the Farmers' alliance through sagacious fusion has attempted to pass, will meet the fate they merit. The controversy over the street railway bill has given the Lowry corporation the friendly and earnest support of an important local element that has before this been extremely antagonistic, and will probably prevent any attempt at severe municipal legislation regulating the street railway service. Everybody is now for Lowry.

Work has been commenced on a new tunnel projected to connect the central power station of the street railway company with the waters of the Mississippi. This tunnel is for dissipating the waste water from the condensers of the several engines, which furnish the company's power, and will be 4½x3 feet in dimension, 25 feet below the street surface. The tunnel previously built for water supply is 50 feet beneath the surface. The new tunnel will be completed within sixty days. N. O. F.

Indianapolis, Ind.

INDIANAPOLIS, Ind , Feb. 21.—Bill No. 179, introduced in the Indiana senate, provides that the suburban street railroads shall be allowed to use the tracks of any existing street railway company for an entrance into a city, upon payment of a fair rental. The measure is probably in the interest of the much talked of Broad Ripple Electric company's line to this city, which has for some time past been trying to secure a right of way into the city, and to the Union railway station, but so far has been unsuccessful because the Citizens' Street Railway company has a monopoly of the streets and alleys in this city.

It was supposed the Broad Ripple line had been abandoned at the time of the misunderstanding between the contractors and those furnishing the capital.

Some of the gentlemen interested in the line say this is not the case, but that the line will be built and in operation this summer.

Two new Julien storage battery cars have been received by the Citizens' Street Railway company to replace those which have been in use on the Irvington road. These cars will be operated by the owner—the Julien company. The Citizens' company will pay a certain rental.

A bill introduced in the legislature authorizes the use of electric motors on street cars in this city. Under the present law and its charter the present company has no legal right to use anything but animal power.

It is possible all the bids for electric lighting of the city will be rejected at the next meeting of the city council, and new bids called for, also bids for furnishing the city a complete plant to do its own lighting. The idea of the city owning its own electric lighting plant seems to be gaining supporters.

Col. Randolph of Chicago, representing the Thomson-Houston company, and H. A. Gooch of the Edison company, have been here looking after their companies' interests. M.

Denver, Colo.

DENVER, Colo., Feb. 20.—A proposition has been made to the city of Trinidad which, if carried to a successful issue, will revolutionize the railroad business of the Rocky Mountain region. The scheme is looked upon as rather visionary, but the earnestness and zeal with which it is being pushed shows that there are a great many people who think it entirely possible It is nothing less than a project to connect Trinidad with the leading gold and silver mining sections of the state by an electric railway. Boston capitalists, whose names have not been given to the puhlic, have made a proposition that for $100,000 and land for terminal facilities they will build and operate such a line, the $100,000 not to be paid them until 100 miles of the road are built and in operation. The proposed line will run from Trinidad to Durango, with a branch to Aspen, in all several hundred miles of road. The object in building the line is to furnish cheap transit for ores to smelters at Trinidad and for coal from Trinidad to the mining regions. The company is to begin work within two years.

Frank A. Miller of the Trinidad Land & Improvement company, has been granted a franchise for electric railway and electric light purposes in that city. There is at present no electric railway in Trinidad, and an electric light plant will be put in in opposition to the one now doing business there.

The Edison General Electric company has established a branch in Denver with George W. Carter as local agent. Mr. Carter has been in charge of the business of the company here for some time. The filing of the articles of incorporation on a capital of $12,000,000 enriched the state treasury to the amount of $1,200. This company equipped the new Colorado Springs electric railway and will probably interest itself in the line to be built at Leadville.

The Leadville & Evergreen Lake Electric company has been incorporated with a capital of $200,000. The purposes of the company are to construct an electric road and telephone line between Leadville and Evergreen Lake. The incorporators are R. E. Goodell, John Law, A. A. Blow, C. W. Kitchen and C. A. Parsons.

The first cars over the new art gallery line to Montclair were started recently. Regular service will be given after March 1.

The Denver & Suburban electric railway has recently placed an order for $75,000 worth of material and equipment which would seem to indicate that the company will do some extensive building in the spring.

Transit facilities on the East Colfax avenue line are being improved. This line runs to Aurora, six miles east of the city. Five new motors were placed on the line recently and contracts have been let which will increase the number of cars to thirty-six by April 1. An independent electric light plant has been contracted for in Aurora which will be furnishing light within sixty days.

Relations between the city council of Highlands and the Western Electric Construction company are somewhat strained because of the failure of the company to furnish the amount of light demanded by private consumers. It is probable that matters will soon be arranged to the satisfaction of all. C. W. C.

Milwaukee, Wis.

MILWAUKEE, Wis., Feb. 21.—At last contracts have been awarded for converting the Cream City and Milwaukee City Railway lines, the most extensive in the city, into electric systems. Both lines are owned by the Villard syndicate, and the Edison General Electric company will furnish the electric equipment. Chief Engineer Henderson, of the Edison company, and two of his associates, were recently in the city, and the matter of contracts was speedily settled The amount of the contracts for electric equipment alone is said to be $1,300,000. In addition, contracts will have to be awarded yet for rebuilding the roadbed, and laying and furnishing 6,000 tons of heavy steel rails. Work will be commenced at once. The Trunk lines, it is understood, will be equipped first.

The Wisconsin Electric Light & Power company has been incorporated with a capital stock of $50,000 already subscribed. The company has secured control of a new dynamo patent which it proposes to sell to various electric light and power companies.

There is a movement on foot to build a small Eiffel tower at Whitefish Bay. Capt. Pabst, the wealthy brewer, and President Pfister, of the Dummy line, are the chief promoters. It is proposed to erect a tower 400 feet in the belief that it would add materially to the attractiveness of the bay.

President Eliot of Harvard College, who has been in the city during the week, declares that there is no scientific laboratory in Massachusetts equal to that at the Milwaukee High School. President Eliot was shown about the laboratory by Profs. Rogers and Peckham, and was very loud in his praises of it. C.

Kansas City, Mo.

KANSAS CITY, Mo., Feb. 21.—Senator Teasdale of this city is chairman of the state legislature committee on corporations other than railroads or insurance. Last week he gave the Kansas City and St. Louis telegraph and telephone men an opportunity to argue against the passage of the pending subway bills. The measure which the committee regards most favorably requires all telegraph, telephone and electric light wires to be placed underground within the next two years. Messrs. Baker and Bahle appeared for the Western Union Telegraph company, and claimed that it would be impracticable to comply with the provisions of such an enactment, and that it would compel them to close up all but three or four of the sub-stations of St. Louis and subject them to endless expense.

Messrs. Weeks and Smith, for the Kansas City electric light and telephone companies, read papers on the inexpediency of subways, and claimed that burying wires had not proved encouraging, and that underground wires were even more dangerous than those overhead.

Senator Stone said the bill was reasonable in its requirements, as it did not require parties to comply with its pro

visions until 1893. It also gave the board of public improvements authority to establish the districts in which the wires should go underground, and to relieve companies from subways in cases where the board should deem it to be impracticable. The senator said that as a matter of fact the wires were now underground in New York, Chicago and Philadelphia, under provisions similar to those proposed, and the movement was successful. It was his purpose, he said, to do something practical, and not destructive of business interests, and he thought his bill was in consonance with the popular demand for relief from the dangerous wires and unsightly poles now prevalent in the business districts of St. Louis and Kansas City.

The Board of Trade of Kansas City, Kan., has taken up the citizens' protest against poor night facilities given that city by the Western Union Telegraph company, and will, at an early date, present the full grievance of the people in writing to the company. P.

Cincinnati, Ohio.

CINCINNATI, Feb. 21.—The Covington & Cincinnati Electric Railway company, equipped with the Short double trolley system, commenced operating cars over its entire line on Sunday, Feb. 8, running by double track between Covington & Cincinnati via the Suspension bridge.

The power station, which is in charge of Andrew Winter, is located at the corner of Front and Greenup streets, Covington, is said to be one of the most complete of its kind in the country. At present it is equipped with two 80-horse power 500-volt Brush generators driven direct by two 100-horse power Armington & Sims' automatic cut off high speed engines. As a reserve there is one 150-horse power 500-volt Brush generator driven direct by a 150-horse power McIntosh & Seymour engine.

The boilers, two in number, furnished by the Lane & Bodley company, of this city, are made of steel and are of the tubular type, seventy-two inch diameter and 18 feet long. The bottom of each boiler over the fire grate is made of one large sheet, thus avoiding joints where they would be exposed to the action of the fire. They are worked under a load of 100 pounds per square inch, and are equipped with Murphy furnaces. The two duplex pumps were furnished by the Laidlaw & Dunn company of this city. A Hoppes Manufacturing company's heater is used.

The cars, fifteen in number, built by the Stephenson company, New York, are very handsome in design and finish, and run very smoothly. Each car is equipped with two 15-horse power 500-volt Brush motors, the Short gears and trucks and the Short sliding contact double trolleys. The weight per car is 12,000 pounds. There are sixteen curves in the line, which is three miles in length. The heaviest grade, 9 per cent., is on Walnut street, Cincinnati, between Pearl and Fourth. Loaded cars come to a full stop anywhere on this grade to permit passengers to alight and proceed again without any apparent difficulty except now and then a little slipping of the wheels on rainy days. The poles used are of the girder type, built of plates and four angle irons. These were furnished by the Walton Architectural Iron company. No. 1 hard drawn copper wire is used on the line. W.

Des Moines, Iowa.

DES MOINES, Iowa, Feb. 21.—The little city of Atlantic has followed the lead of many other Iowa cities and has substituted electric for gas light. The plant is owned and operated by the city. The current was turned on for the first time last week and the system was found to be entirely satisfactory. Every street in the city is covered by the circuit. When entirely completed the plant will be second to none in the state.

The Des Moines Electric Railway company has in process of construction at Akron, Ohio, an eighteen cell storage battery of the Hess pattern which, when completed, will be used on one of the cars in this city. The experiment will be watched with interest as it will, if successful, result in the adoption of storage batteries on all the lines of the system.

The controversy between the Des Moines city council and the Central Union Telephone company has resulted in the passage of an ordinance which grants a franchise to the company on condition that the city share in the receipts of the company. It was discovered during the past year that the telephone company had been operating its lines upon the streets of Des Moines for years without having accepted the terms of the franchise ordinance passed by the council or complying with its conditions, and therefore was operating without authority. A demand was at once made from certain quarters that the city should not grant a new franchise to the company without receiving a money consideration therefor. The ordinance prepared and passed by the council acquiesces in the demand and provides that the telephone company shall, during the continuance of the franchise be required to furnish to the city free of charge fifteen telephones, and also pay to the city annually three per cent. of its gross receipts for telephone service. The receipts of the company are estimated at about $40,000 annually. The franchise is only granted for two years from March 31st next. The manager of the company declares that the ordinace cannot be accepted.

Cherokee's electric light plant is just completed. The machinery and everything connected with the plant is of the best. As it looks now the capacity of the plant will have to be increased before long. The capacity for incandescent lamps, 16-candle power, is given at 650, and already over 700 are spoken for. It has a capacity of 30–1,200 candle power arc lights. F. M. C.

THE ELECTRIC MOTOR.

The Continental Electric Construction company of Chicago, has been organized; capital stock, $250,000; to build, equip and operate street railways, electric light, power and heating plants, and to do a general electric manufacturing business. Incorporators, William F. Orrell, Oren I. Wheat and Leslie C. Orrell.

Chadbourne, Hazelton & Co. of Philadelphia, have recently closed a contract with the Athens Street Railway company, Athens, Ga , for the entire equipment of its line. The new slow speed direct gear Wenstrom motor will be used. The station will be equipped with the Wenstrom apparatus throughout. One 50 000 watt generator will furnish the power for the five cars. Standard Brill trucks will be used, and the entire equipment will be first-class in every respect. The road is about five miles long, and runs from Macon to Athens. Ga.

Chadbourne, Hazelton & Co., general agents of the Wenstrom Consolidated Dynamo & Motor company, of Baltimore, have just closed a contract with the Denver, Lakewood and Golden Railway company, of Denver, Colorado, for an extensive electric railway. This road runs from the heart of Denver directly across the country to the city of Golden, a distance of fourteen miles, passing through several smaller towns on the way. The grading on this road is completed, and the work of laying the rails is about commenced. Sixty-pound T-rail will be used. This road is the only direct communication between these two cities, and Mr. Starkweather, vice-president and general manager of the road, claims that the freight business alone on this line will pay a ten per cent. dividend on the investment. The equipment at first will consist of two 100 horse power motor cars, designed by Leonard Atwood, mechanical expert, employed by Chadbourne, Hazelton & Co. These motor cars will be fitted with special Wenstrom slow speed direct geared motors, designed by H. F. Parshall, on the same general lines as the regular Wenstrom-Parshall slow speed street car motor. These are guaranteed to draw cars at the rate of twenty-five or thirty miles an hour, and haul loaded freight cars. For the passenger traffic, long 8 wheel cars with pivotal trucks will be used. These cars will be handsomely fitted up, and will have a seating capacity of about forty people. Two standard Wenstrom slow speed, direct geared motors, 30-horse power each, will be put on these cars. They are calculated to run fifteen or twenty miles an hour, hauling two trail cars. The power plant will be divided into two sections; one station being in Golden, the other near Denver. Each one will be fitted up with four 80,000 watt Wenstrom street car generators, of the newest design, together with the necessary steam plant. Mr. Atwood, expert of the firm, has been in Denver for some weeks going over this work, and laying out necessary plans for the successful equipment of the entire line. It is intended to have the road open for traffic as near the first of May as possible. The equipment will be increased very materially during the summer, as the traffic over this line is expected to be very great.

Personal Mention.

Albert E. Rich of the Hunt Engineering company, Brooklyn, N. Y., was recently in Chicago.

E. E. Higgins has resigned from the Edison General Electric company to accept a similar position with the Thomson-Houston Electric company.

William S. Logue of Orange, N. J., representing Edison's phonoplex system of telegraphy, and the Edison Manufacturing company, was in Chicago recently.

W. B. Ferguson, formerly with the Thomson-Houston Electric company, has been appointed the New England agent for the Detroit Electrical works. He has already secured an order for an installation of the Rae system.

Business Mention.

The Crocker-Wheeler Motor company, New York, has secured as sales agent George W. La Rue, who has been connected with the Sprague Electric Railway & Motor company as agent in the East.

The Walter Hay Manufacturing company, of Chicago, received within the last week orders for over 2,000 of its improved electric bells. The orders came from firms which had thoroughly tested the bell. The company is making a special annunciator for the Falls City fire department of Falls City, Neb.

The Electrical Supply company of Chicago, is having more than usual success with the Simpson storage battery. Dentists and physicians find these small secondary batteries peculiarly convenient for their purposes, and for small lighting and power purposes and various domestic uses, they are just the thing. The batteries furnished are two, three or four 20 ampere hour cells, and come in neat, portable oak cases. They are sold very low, but are as carefully made as the larger commercial batteries.

The Crocker-Wheeler Electric Motor company of New York has been fortunate in securing the services of William D. Palen as electrician in charge of the testing and inspection of apparatus in the large factory. Mr. Palen was formerly connected with the Edison company, and is known as a thoroughly capable electrician.

W. S. Rogers, of the Thomas Murray company of New York, will have charge of the Grand View Beach electric railway, which extends from Charlotte along the beach seven and one-half miles, to Manitou Beach, Rochester, N. J. This line will be equipped with the Rae system. The start will be made with seven motor cars and seven trailers, each motor car being driven by a 40 horse-power motor. It is expected that the road will be running by May 15.

W. S. Krotz, superintendent and electrician of the Defiance, O., Electric company, wrote the following letter to the Electric Supply company: "Two years ago this spring some time I was given a Perkins incandescent lamp and holder as a sample. I put the lamp up in the dynamo room at that time and it has been running all night ever since—over seven thousand hours. It is a 110 volt lamp, and it is burned until 1 A. M. at that voltage. It is then burned at 90 volts until morning."

Wilson, Rebenstock & Co., 174 So. Clark street, Chicago, have recently added some new machinery to their factory and are now better than ever prepared to assist inventors in the perfection of their apparatus. They also manufacture testing sets and all kinds of electrical instruments. The firm is composed of D. H. Wilson and Geo. Rebenstock, two well known electricians, who will at any time give their time and experience in consultation without charge. Mr. Wilson is the inventor of the appliances used by the American Electrical Fence company, of which company he is now the consulting electrician, and has just patented a new gravity battery that apparently has a high efficiency. These gentlemen are accommodating and painstaking and will undoubtedly meet with succes in their new undertaking.

To no company or firm in the United States is more credit due for the perfection of the street railway motor truck than to the McGuire Manufacturing company of Chicago. The McGuire truck was recently illustrated in the WESTERN ELECTRICIAN, and stands in need of no further words of commendation at this time. A sufficient proof of the superiority of the truck lies in the fact that it has been adopted and is now in use by over fifty electric street railway corporations. Among the most important of the recent contracts are the following: Dubuque Electric Railway Light and Power company, 8 steel motor trucks and 2 trailers; Cicero & Proviso Railway company, 24 double trucks; Seattle Electric Railway & Power company, 18 trucks; Newark (N. J.) Street Railway—of which Judge Altgeld of Chicago is president—6 motor cars.

Mr. Hood of the Chicago Wood Mat company has been making a series of experiments having in view the perfection of his wood mat for electric motors, and other street cars. For motor cars the leading companies are now adopting the mat or flooring permanently built in the car, which is Mr. Hood's invention. These floors are very desirable for electric motors, as they are rigid, permitting a trap to be cut through, and are easily handled for the necessary repair and inspection of the motors. With a loose or flexible matting on the floor this becomes a great annoyance, but with ordinary street cars or trailers a movable mat is desirable. To meet this demand this company has heretofore made a flexible wood mat held together with wire, but exposed to the weather the iron would rust, and after folding for a time the strands would break. To meet this objection Mr. Hood has substituted for the wire a flax sash cord, coated with asphaltum varnish, rendering it impervious to water, each slat being held its proper distance apart by a wire ring washer strung on the cord. The cord has all the strength of the wire, and treated with varnish will make a matting that it is claimed will be practically indestructible. The Pullman company are using this matting in large quantities, and the factory at 247 North Wells street is now being run to its full capacity to meet current orders.

It is a well established fact that steam when being conveyed to an engine contains a large percentage of water, resulting from entrainment of water from the boiler during rapid evaporation, and condensation in the pipe connections between the boiler and engine. Water conveyed by the steam to an engine, not only represents a large percentage of loss, but also introduces an element of danger, especially to the high speed engines of the present day, in which clearances are reduced to a minimum. The separator, manufactured by the Pond Engineering company, of St. Louis, is so placed in the line of pipe near the engine, that all the steam conveyed to the engine must pass through it, and consists of an outer cylindrical shell into which the steam enters with the entrained water, and leaves through an inner pipe extending from the top down about one-half the length of the separator, by which arrangement an annular space is left between the two. The lower part of the separator is enlarged and forms a receiver of sufficient capacity to provide for any sudden flow of water from the boiler. An opening of proper size is provided at the bottom for removing the water, and a glass water gauge is supplied to show the level of the water at all times in the separator. A flange connection is made between the upper and lower part of the separator, so that it can be easily opened for inspection, without breaking any joints in the line of pipe. The separator is guaranteed to relieve the steam of all entrained water and return this water to the boiler, either direct or by means of a trap, as the location of the separator may determine.

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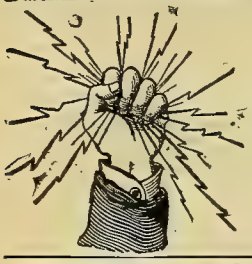

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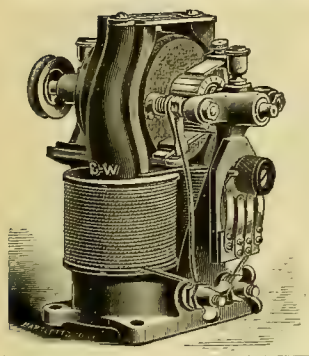

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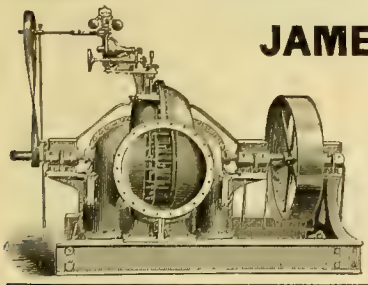

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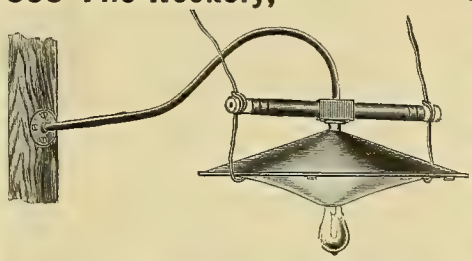

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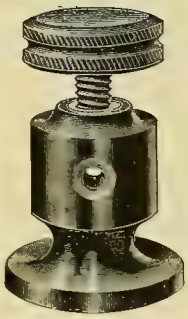

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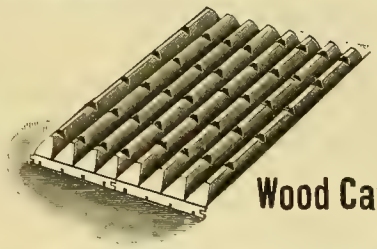

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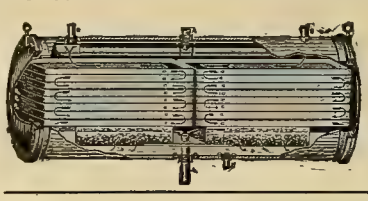

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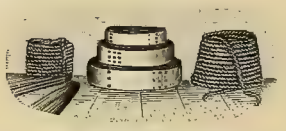

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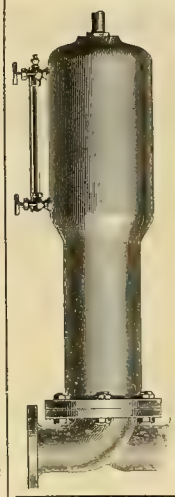

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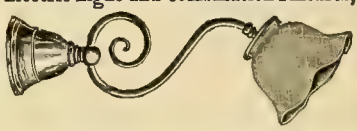

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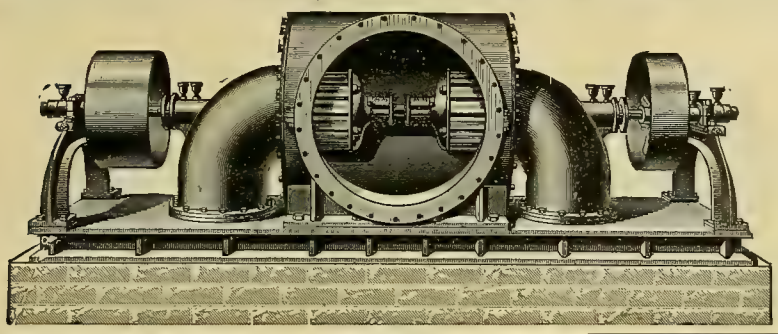

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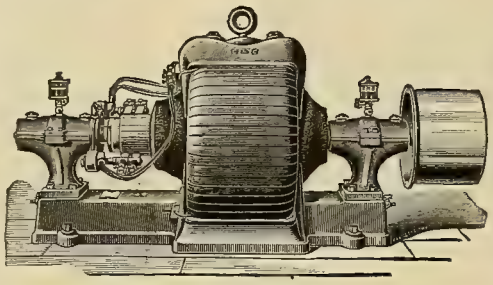

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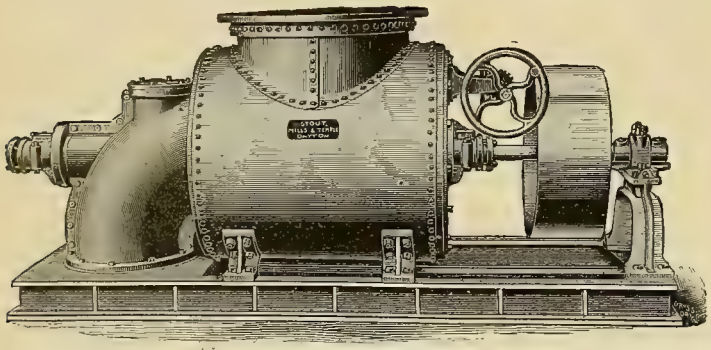

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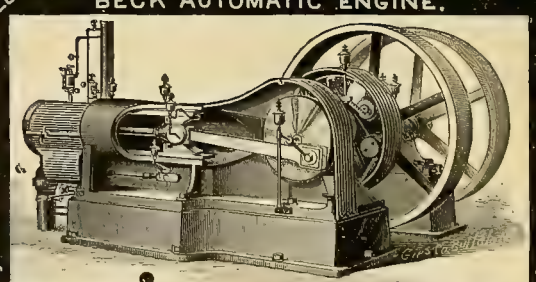

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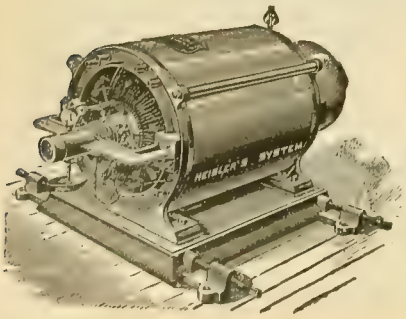

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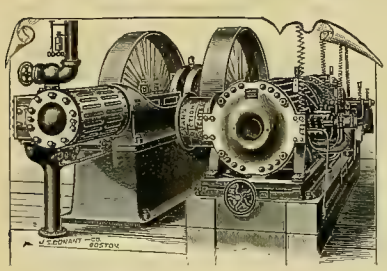

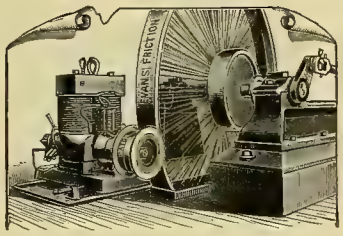

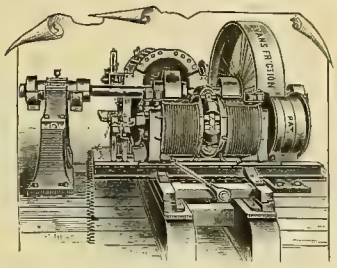

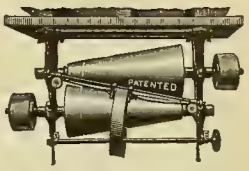

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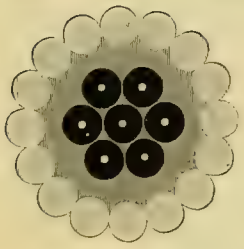

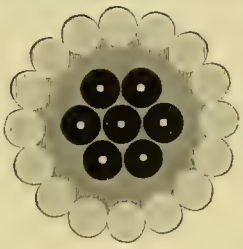

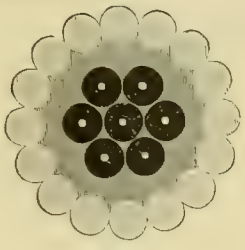

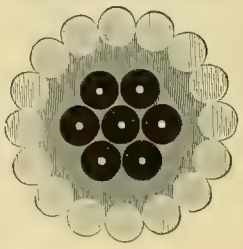

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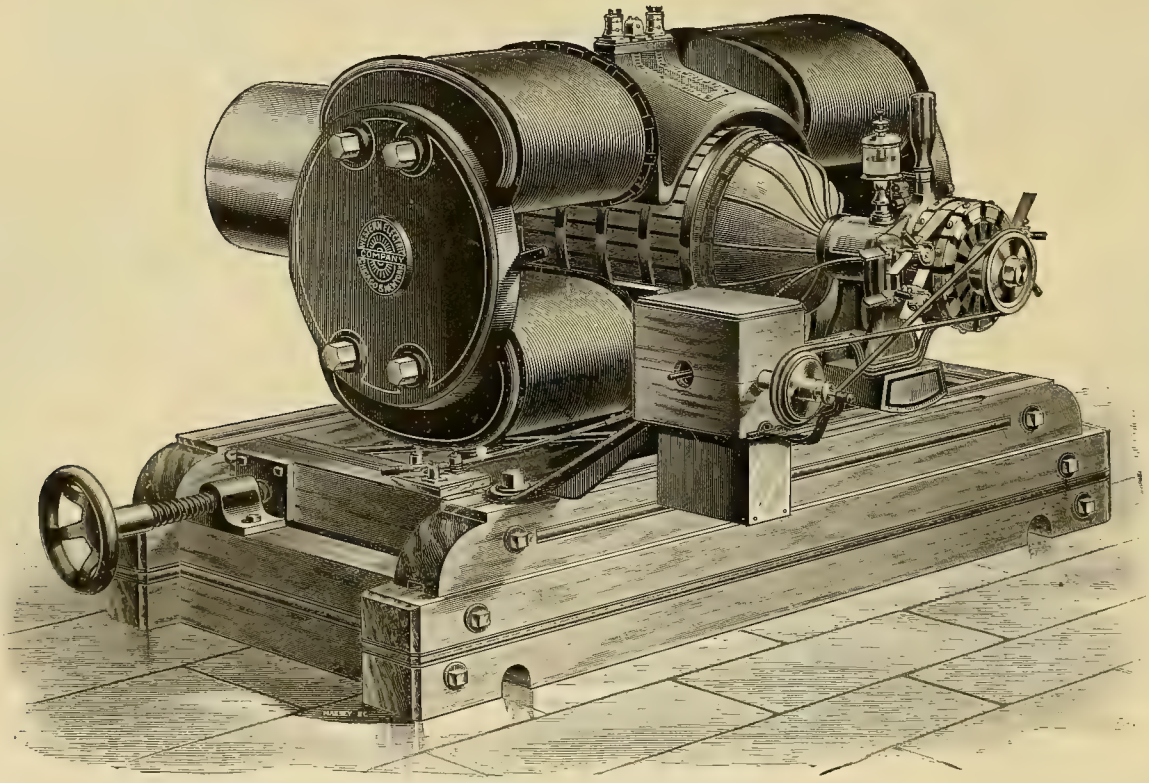

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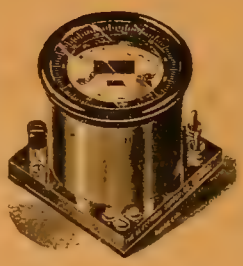
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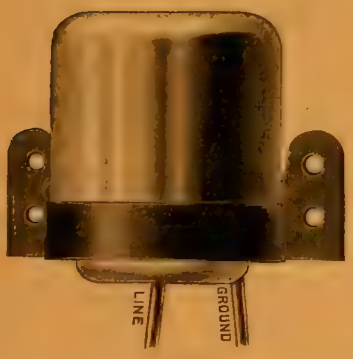

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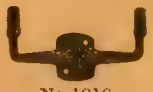
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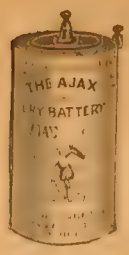

(Patents applied for.)

HIGH INSULATION BRACKETS.

SEE

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SEE

Catalogue No. 648 for District Messenger and Fire Alarm Supplies, Bells, Batteries, Etc.

THE ELECTRICAL SUPPLY CO.

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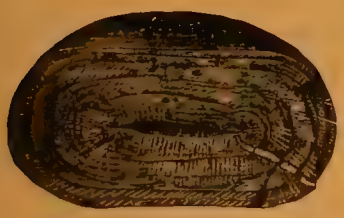
We are particularly desirous, and in fact make a specialty of furnishing large Habirshaw Cores to fulfill unusual and difficult conditions of installation. Of the quality of the Cores furnished, we can assure our customers that they are manufactured in the most scientific and painstaking manner, and that every precaution is taken to guard against every possible difficulty that may arise. Special attention is called to the uniformity and exact dimensions of the large Cores as evidencing the care with which they are manufactured. A large number of the special Cores have been made during the past five years, and that there have been no failures is the strongest confirmation of our claim to superiority. We can aver, without fear of contradiction, that no other manufacturer of heavy rubber Cores, has given equal attention to this branch of his product.

No list prices can be given as the cores are made especially to suit given conditions which radically differ in each case. We shall be pleased to quote prices upon receipt of the special information requested on page 7 of our catalogue No. 732.

See Catalogue No. 732 for further particulars regarding Habirshaw insulation.

The Two Principal Sources of Rubber Supply.



(Pure Para Rubber Stock.)

("Recovered" Rubber Stock.)

It is a fact, though not generally known, that the larger part of manufactured rubber goods is made from so called "recovered rubber," principally from old rubber boots, shoes, rubber hose, rubber springs, packing, etc. Rubber that has been vulcanized is no longer rubber but a chemical compound of sulphur and rubber, and is not capable of being treated or worked as pure rubber. Goods manufactured from "recovered" rubber bear the same relation to goods made from pure rubber that shoddy bears to genu'ne woolen goods.

The following extracts from a report of analysis and tests on various samples of insulated wire will be of interest in this connection. The authority from which we quote is one well known, and with a reputation second to none. We refer to the samples by letters in preference to using the trade names:

Sample "*A*" shows 15 per cent. of a heavy hydro carbon similar to ozokerite, and assimilating to an article known in Europe as nigrite.

Sample "*B*" has been made over from "recovered" rubber, or a mixture of "recovered" rubber and oxidized oils.

Sample "*C*" shows by analysis very nearly 30 per cent. of adulteration, consisting chiefly of oxidized oils. The process is known as "spurted" or "spewed" insulation. (See note below.)

Sample "*D*." Several samples of this insulation were taken, all of which varied. The composition of the rubber is "way off," being largely made up of a heavy substance similar to white lead. The white layer goes to pieces very rapidly.

Sample "*E*," HABIRSHAW, is the only one of the samples tested, which by analysis shows that pure Para Rubber is the only organic substance used in the insulation.

Sample "*F*" has about 5 per cent. of resin. It is poorly manufactured, the "spurted" process being used.

Sample "*G*" is made and built upon the same plan as "*F*," containing a mixture of resins. This insulation is perhaps the poorest made of any, and shows a very imperfect knowledge of manufacture. The "spurted" process is used.

NOTE.—"Spurted" or "spewed" insulation, so far as known, cannot be made of pure rubber compound. The only claim that can be made for it is that it produces an insulation which is seamless, *but this condition is got at the expense of the quality of the insulating material.* On this question of having a seam, there is only one view to be taken: it is stronger than the other, provided the manufacture is carried on correctly; if not it is like all other badly made things, "good for nothing."

And the Result, as Demonstrated by a Simple Test.

1. 2. 3. 4.

The accompanying cuts represent the characteristic results of a qualitative test on the composition of 13 samples of so-called rubber wires. This test was made by removing the outer covering of each sample—all braid, paint, etc.—and then paring off the insulating material and putting in a bottle with naphtha. The action of naphtha on "rubber" wire covering is briefly as follows:

1—To swell the rubber without dissolving.

2—By this action to loosen and precipitate mineral impurities and adulterations to some extent

3—To dissolve waxes, ozokerites, oil compounds, etc.

This test, while by no means exhaustive, is more instructive and valuable than any single test that can be applied in the laboratory—far more valuable than insulation tests—and when the final rub, the test of time, cannot be awaited it will serve to show the ridiculous pretensions of the makers of many "Best Rubber Wires."

Our samples, in the test here illustrated at the end of three months, included all the well-known gum insulations in the market (we dislike to say "Rubber") and some not so well known, which are none the worse for that.

Number of samples represented by Figure 1..... 1
Character, clear liquor, very heavy white mineral deposit. Showing the compound to be heavily adulterated with white lead.

Number of samples represented by Figure 2..... 8
Character, inky black liquor from dissolved gums, oils or resins, other than rubber.

Number of samples represented by Figure 3..... 3
Character, black and dirty liquor. Abundant chalky or dirty mineral deposit.

Number of samples represented by Figure 4..... 1
Contents all kinds of ***HABIRSHAW***.

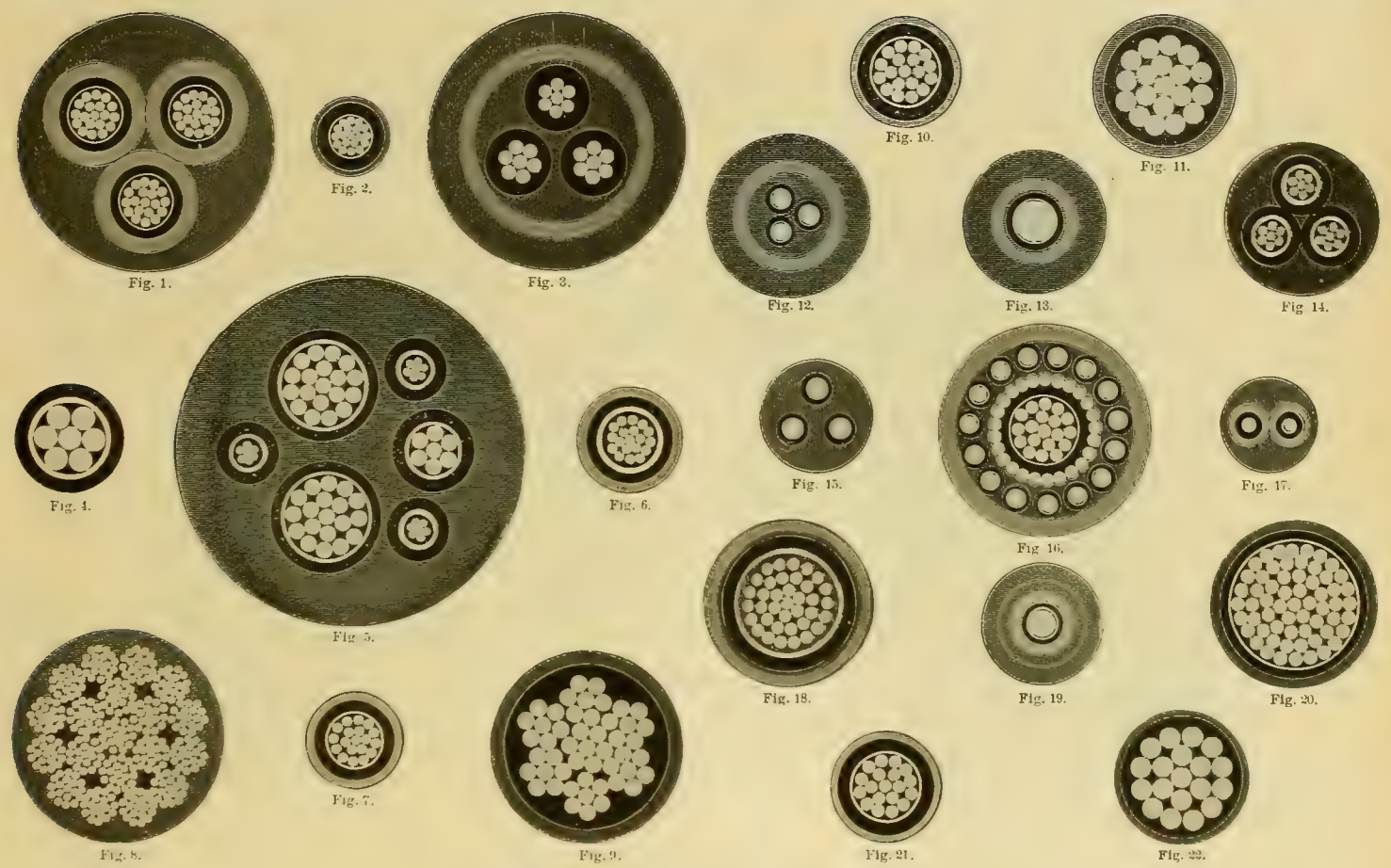
Character, clear liquor showing absence of gums, oils or resins, other than rubber. No deposit, showing absence of dirt or mineral impurity.

Number of samples tested..... 13

Pure Para Rubber is the only Organic Substance used in the Habirshaw Insulation.

THE ELECTRICAL SUPPLY CO.
171 RANDOLPH ST.
CHICAGO.

SPECIAL HABIRSHAW CORES.



DESCRIPTION.

Figure 1.—Feeder Core. Three circuit. Outside diameter 1 12-16 inches. 120,000 circular mils. Insulated with rubber and leaded.

This class of Cores is furnished from 20,000 to 150,000 circular mils, and is similar to those furnished the Brooklyn Edison Co., Brooklyn, New York, and the Edison Illuminating Co., New York.

Figure 2.—Land Core, leaded. Outside diameter 9-16 inches. Used in the Interior Department, Washington, Brush Incandescent Installation.

Figure 3.—Feeder Core. Three circuit. Outside diameter 1 12-16 inches. 120,000 circular mils.

The construction is similar to Figure 1, with the exception that the lead protection is placed around all three strands together instead of each one separately. This particular Core was used by the Brooklyn Edison Electric Light Company.

Figure 4.—Dynamo Feeders and general service. Outside diameter 12-16 inches. These Cores are made in all sizes.

Figure 5.—For Submarine work. Outside diameter 2 5-16 inches. 450,000 circular mils. This has no lead protection or outside armoring, but instead is covered with jute, which is now largely used in the telegraph service in Europe, and is found to wear better and give better protection. Being more flexible it protects the cable from being broken and pulled apart. This particular Core was used by the Edison Electric Light Co., Easton, Pa., to lay across the Delaware River.

Figure 6.—Marine Core. Outside diameter 12-16 inches. Habirshaw insulation, lead covered. This Core is used on all of the Government Cruisers.

Figure 7.—Land Core, leaded. Outside diameter 10-16 inches. Conductor composed of 19 No. 16 B. W. G. Wires.

This particular Core was used in the installation of the Steamer Puritan.

Figure 8.—Feeder Cable. Outside diameter 1 7-16 inches. 700,000 circular mils. Composed of 361 No. 17 B. & S. wires.

This particular Cable was used for ducts in the streets by the Brooklyn Edison Electric Light Co., Brooklyn, New York.

Figure 9.—Feeder Cable. Outside diameter 1 5-16 inches. 500,000 circular mils, Habirshaw insulation.

This style of Feeder Cable was used in the Brooklyn Edison Electric Light Station, New York.

Figure 10.—Feeder Conductor for dry places. Three circuit. Outside diameter 14-16 inches. 120,000 circular mils.

A conductor similar to this was used in the Grand Central Depot Installation, New York.

Figure 11.—Feeder Conductor. Outside diameter 15-16 inches. 300,000 circular mils.

Figure 12.—Underground Core. Three Conductor. Triangular arrangement. Outside diameter 1 2-16 inches. This Core is encased in lead, and is served with an outside protection.

Used for underground work in the New Jersey Central Railway Depot, opposite New York. Edison Installation.

Figure 13.—Underground Core. Outside diameter one inch. Habirshaw Insulation, leaded, and lead protected with an outside serving.

Figure 14.—Portable Cable. Three strands. Nos. 7 and 14 B. & S.

This class of cables is used for stage light, scenery light, and other special service in theatres. The outside serving is flame-proof.

The Cable illustrated was used in the Broadway Theatre, New York. Edison Installation.

Figure 15.—Feeder Cable. Outside diameter 12-16 inches. Habirshaw Insulation. Not leaded.

Figure 16.—Underground Core. Three circuit. Outside diameter 1 7-16 inches. 250,000 circular mils. Habirshaw Insulation, lead covered.

Used by the Harrisburg Electric Light Co., Harrisburg, Pa., for underground work. Edison Installation.

Figure 17.—Underground Core. Two circuit. Composed of two No. 16 B. W. G. Wires. Habirshaw Insulation.

This Conductor was used by the Troy Fire Department.

Figure 18.—Naval Core. Lead encased. Outside diameter 1 3-16 inches. 255,000 circular mils.

Core similar to this was used for dynamo leads on all of the new Government Cruisers: San Francisco, Boston, Chicago, Charleston, etc.

Figure 19.—Underground Conductor. Outside diameter 13-16 inches. Habirshaw Insulation, not leaded.

Conductor similar to this was used in the installation of the New Jersey Central Railway Depot, opposite New York.

Figure 20.—Feeder Core. Outside diameter 1 3-16 inches. 420,000 circular mils. Composed of 61 No. 14 B. W. G. Wires.

Used in the installation of the Broadway Theatre, New York City, New York.

Figure 21.—Feeder Conductor. Outside diameter 12-16 inches. Habirshaw Insulation. Outside flame-proof.

Used in the installation of the Mount Morris Electric Light Station, New York.

Figure 22.—Feeder Conductor. Outside diameter 15-16 inches. 250,000 circular mils. This class of goods is furnished from 100,000 to 900,000 circular mils. It is entirely for use in dry places, like well constructed stations. It is also valuable for running through the station, under sidewalks and ducts to the street to make connections. The insulation will answer every purpose for the uses and conditions above mentioned, but it is not intended for underground service.

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Leather Belts.

Reduced Photograph.

1 72-inch, 2-ply Belt } Second order { *Louisiana Electric Light Co., New Orleans, La.*
2 48-inch, 2-ply Belt }

1 54-inch, 3-ply Perforated. *Tacoma Railway & Motor Co., Tacoma, Wash.*

2 30-inch, 3-ply Perforated. { *Gautier Steel Dept.* / *Cambria Iron Co.* } *Johnstown, Pa.*

1 41-inch, 3-ply Electric. *Citizens' Electric Light Co., Brooklyn, N. Y.*

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Ship by express nine thousand feet two naught
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BARNES' NEW SENSITIVE DRILL

Speed, from 0 to 1600 revolutions without stopping the machine or shifting belts.

This new sensitive drill embodies principles not found in other tools of its class, is simpler in construction and more effective in operation than any sensitive drill in the market.

The speed of the drill spindle can be *increased or diminished instantly*, or the *motion reversed* without stopping the machine or *shifting belts*.

More or less driving power can be applied to the drill spindle, as the size of the drill or the nature of the work may demand.

We claim for this drill superiority both in simplicity of construction, which renders it less liable to derangement, and in effectiveness of operation, on account of the variation of speed and power being so completely under the control of the operator, whereby all the adjustments are made with the least possible loss of time. It is smooth and almost noiseless in operation, and entirely free from the vibratory motion commonly found in drills of this class, where the spindle is driven by belt.

Sold subject to trial, with single or multiple spindle. Send for Catalogue.

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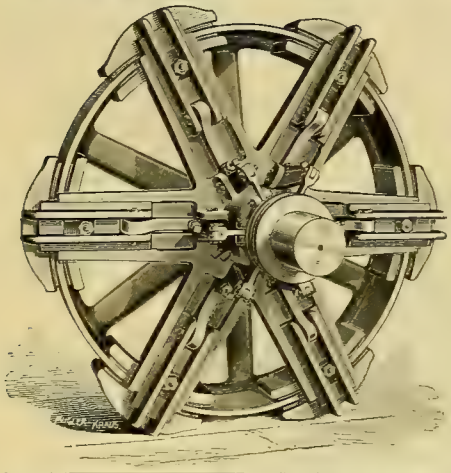

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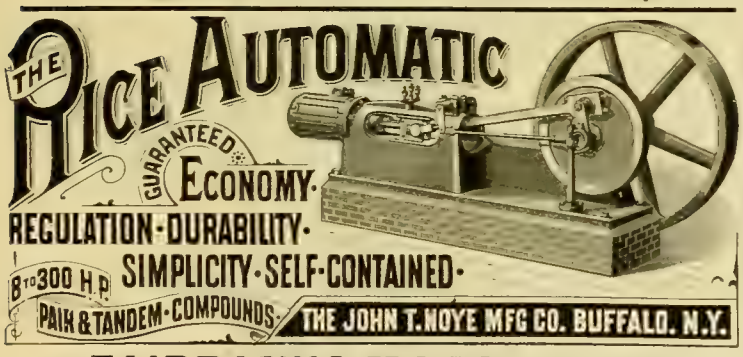

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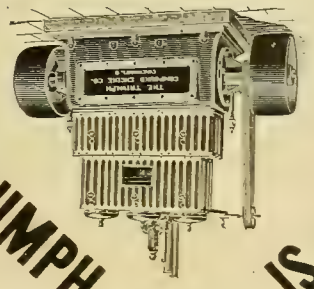

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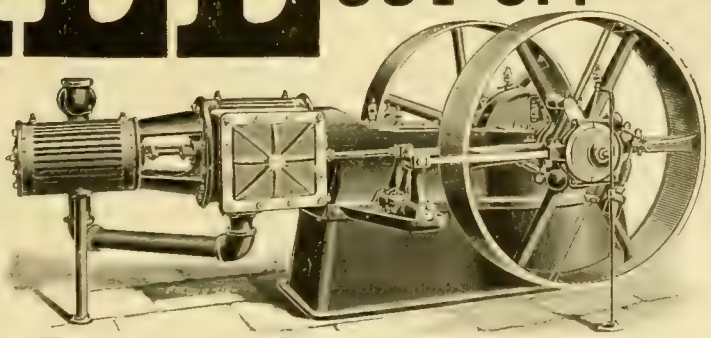

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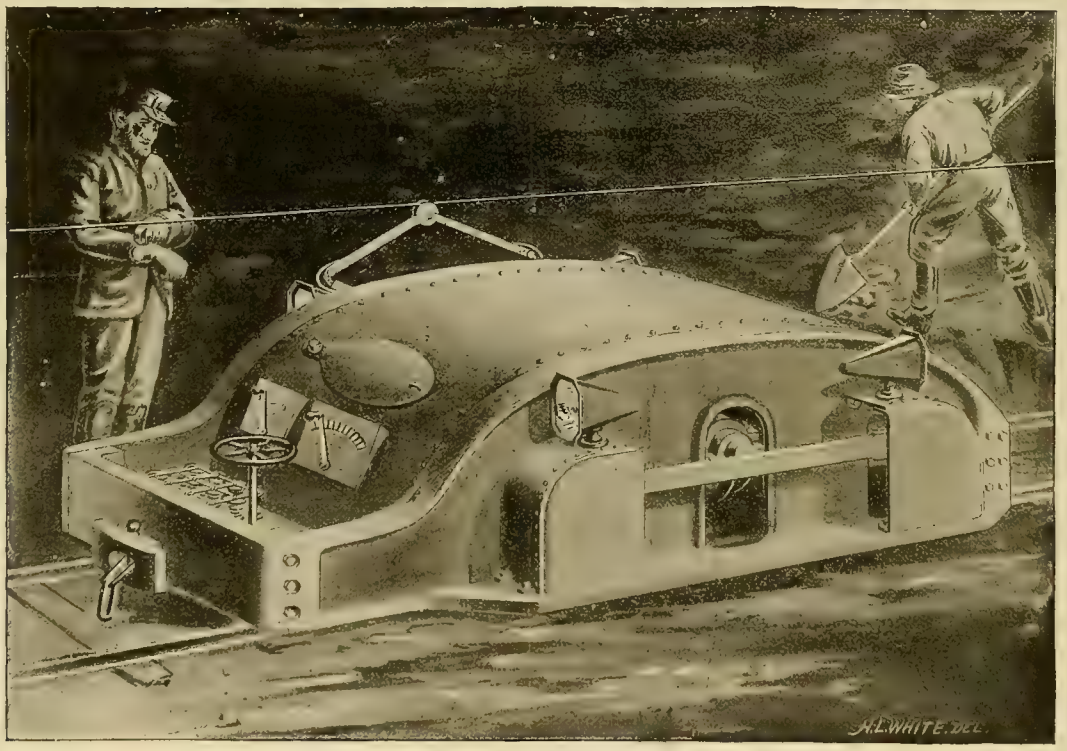

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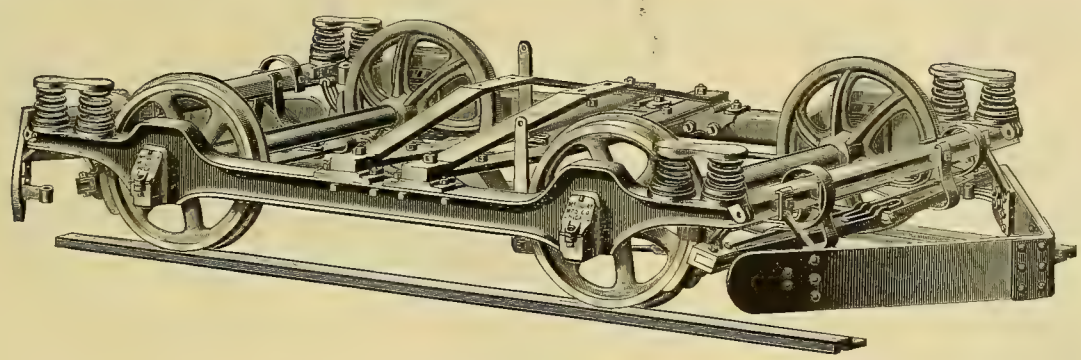

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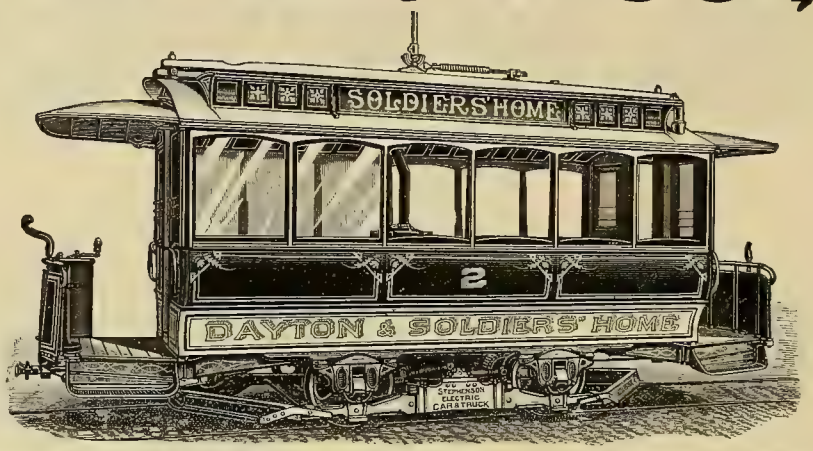

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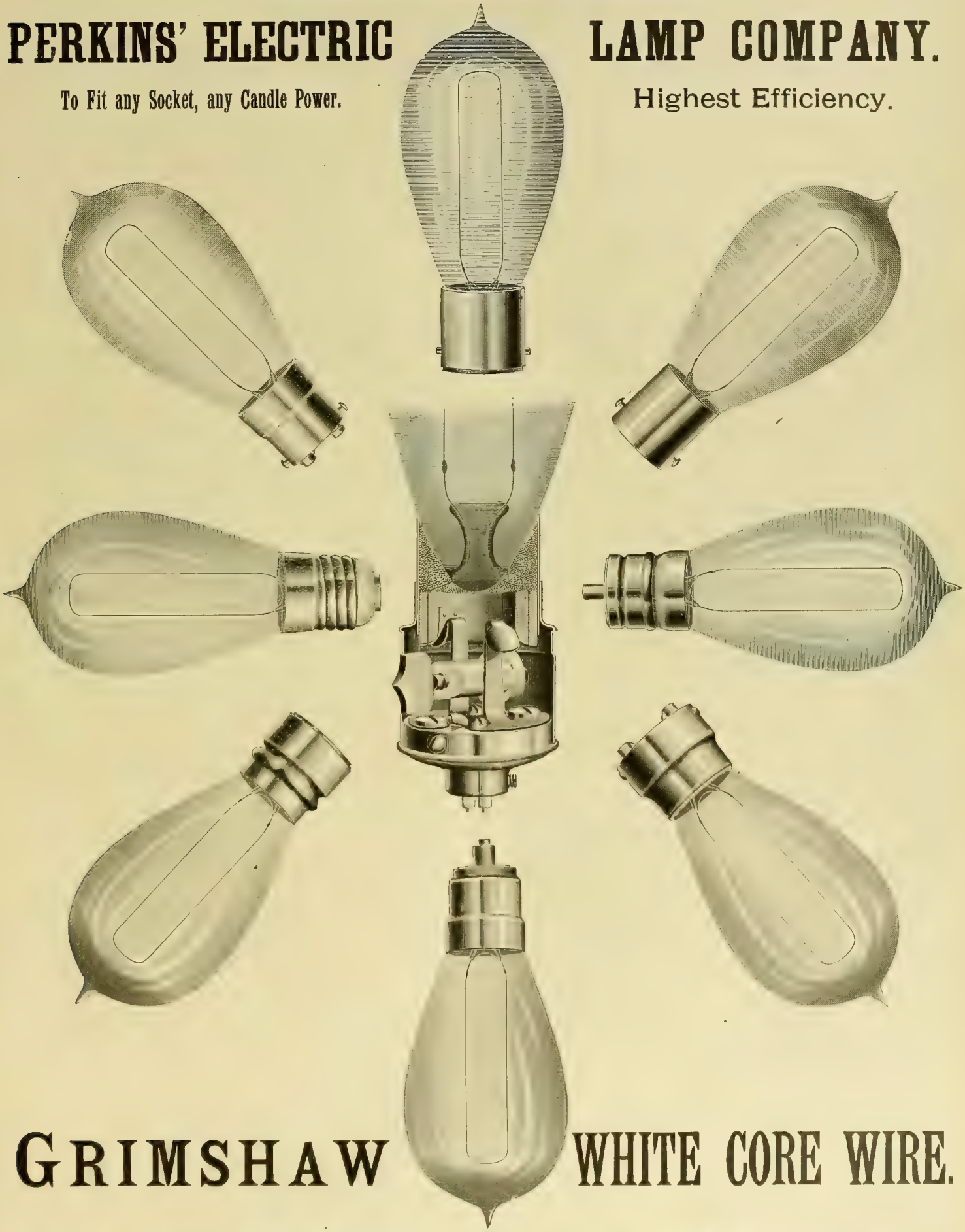

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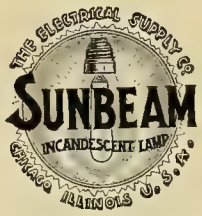

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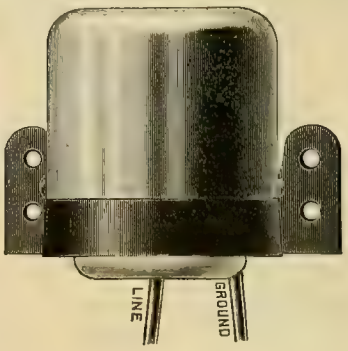

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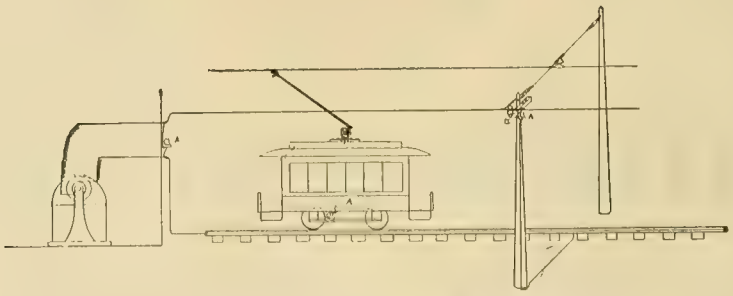

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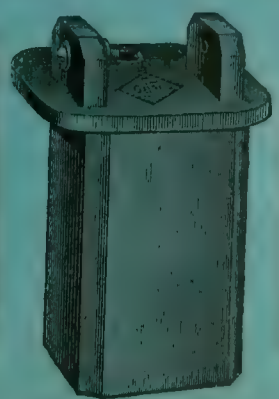

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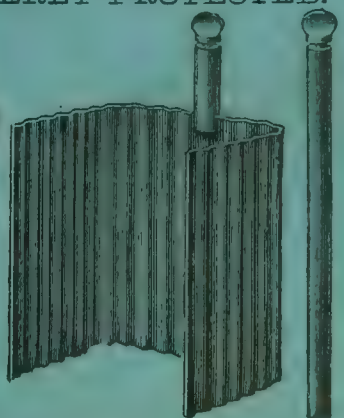

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Accumulator Co , The.
Brush Electric Co.

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Cowles Electric Smelting & Refining Co.
Cleveland Aluminum Co.

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Holtzer Cabot Electric Co.
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Standard Electrical Works.
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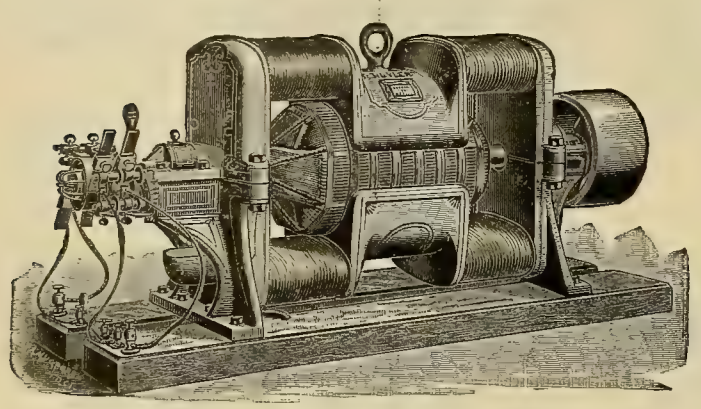

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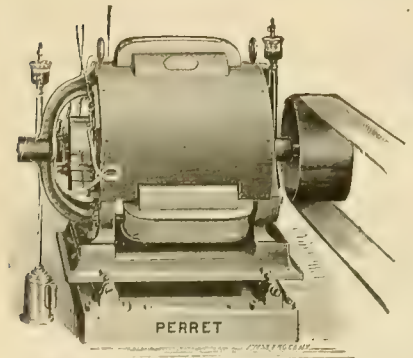

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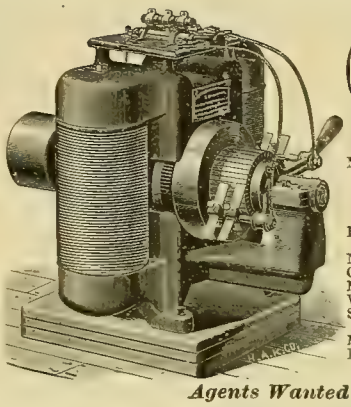

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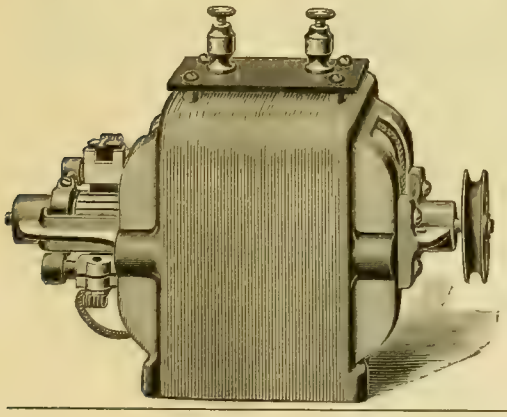

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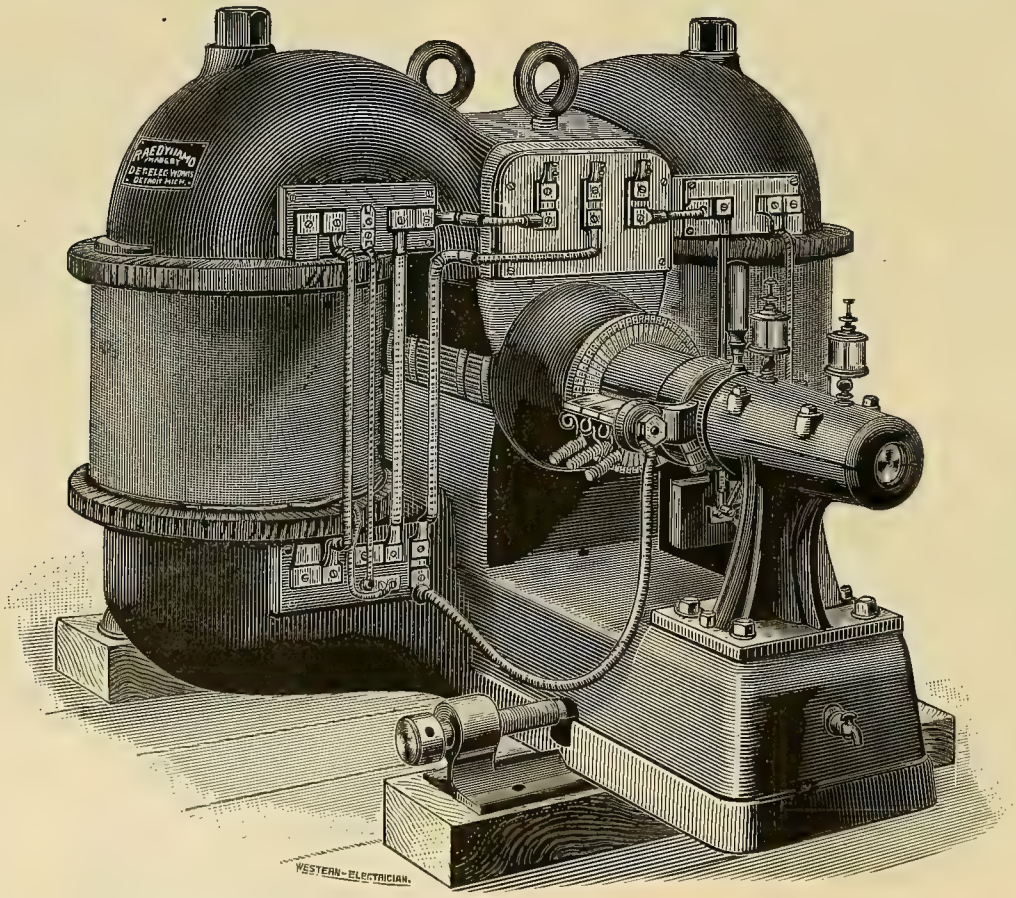

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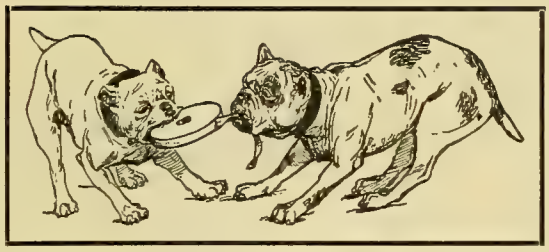

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This insulator is universally commended by Railroad men as the most practical and thorough span wire insulator yet brought to their notice.

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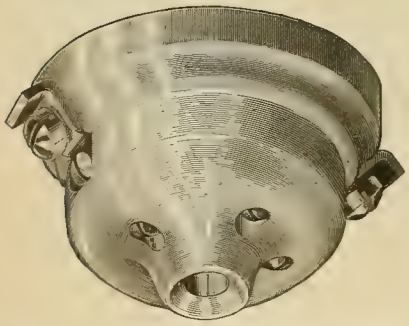

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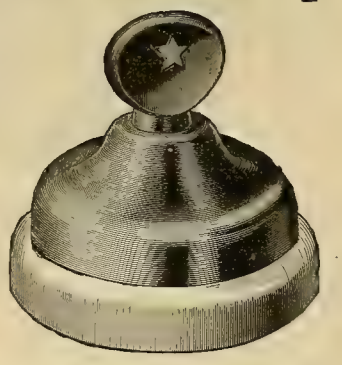

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GENTLEMEN:—The two cells of the Axo pattern of your battery, sent me for trial a long time ago have proved to be a most excellent type of cell. One of them I have used for two years and more to furnish the main current in the Rayleigh method of comparing E. M. F. of my standard cells, and it is still in use for the same purpose. The E. M. F. falls to be sure, but only very slowly indeed. *It is now 1.52 true volts after 2 years' service, and the cell has never had a drop of liquid added to it since it was first set up.*

Since your two cells were put into service I have employed a systematic plan of testing, and I can testify to the excellent qualities of the Axo battery from the tests made. Very truly yours,

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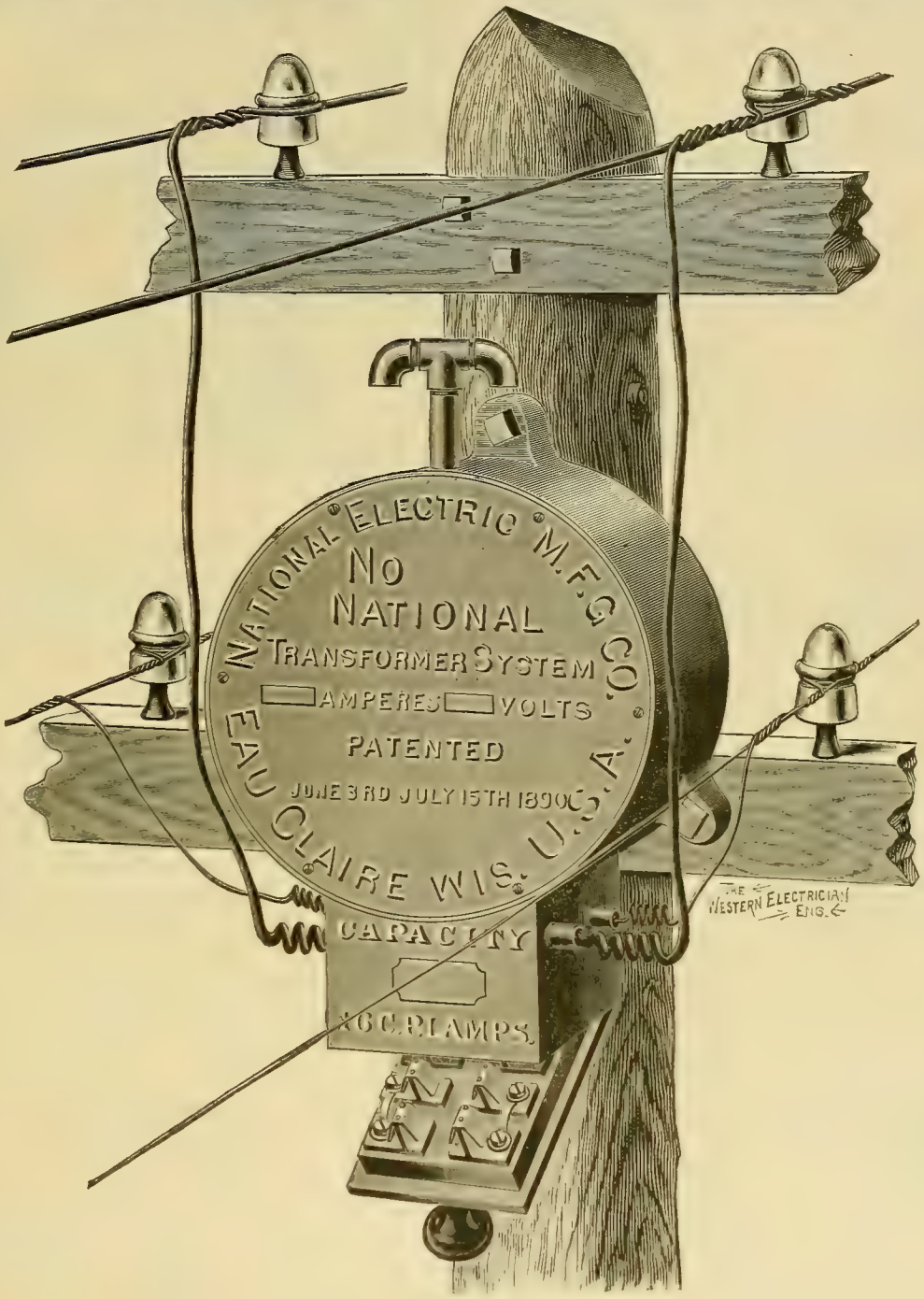

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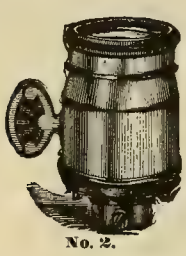
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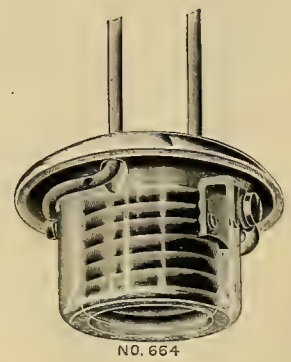
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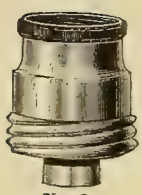
Cat. No.	DESCRIPTION.		Price.	Price to Purchaser, 45% off List.
1	Standard Keyless Socket	Plain	$0.45	$0.247
1	" " "	Polished Brass	.50	.275
2	" Key "	Plain	.75	.412
2	" " "	Polished Brass	.80	.44
2½	" Push-button Socket	Plain	.75	.412
2½	" " " "	Polished Brass	.80	.44
3	" Keyless Receptacle on Wood or Porcelain Base	Plain	.40	.22
		Polished Brass	.45	.247
7	Standard Key Receptacle on Wood or Porcelain Base	Plain	.73	.401
		Polished Brass	.77	.423
6	Standard Keyless Socket	Plain	.50	.275
6	" " "	Polished Brass	.55	.302
3½	Fancy Keyless Receptacle with Wooden Base	Plain Brass	.45	.247
		Polished Brass	.50	.275
3½	Fancy Keyless Receptable fancy Porcelain Base	Plain Brass	.50	.275
		Polished Brass	.54	.297
8	Fancy Keyless Receptacle with Wooden Base	Plain	.85	.467
		Polished Brass	.90	.495
8	Fancy Keyless Receptacle with Porcelain Base	Plain	.90	.495
		Polished Brass	.94	.517
369	Wood "Testing Socket," with Outside Screw Connections		.40	.22
667	Improved Porcelain Waterproof Socket with Rubber Ring		.75	.412
664	Waterproof Glass Socket (Patented)		.75	.412
666	Improved Waterproof Hard Rubber Socket with 10 inches Rubber covered Wire		.75	.412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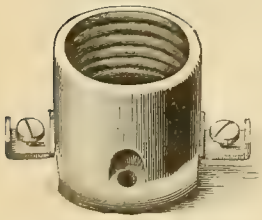
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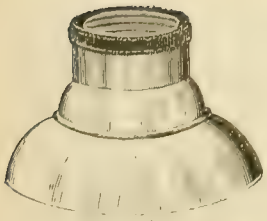
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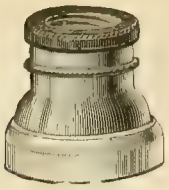
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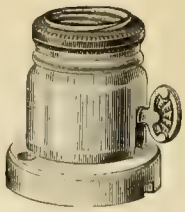
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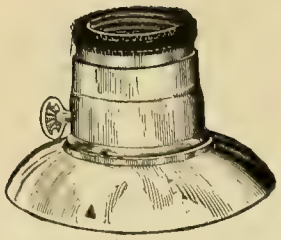
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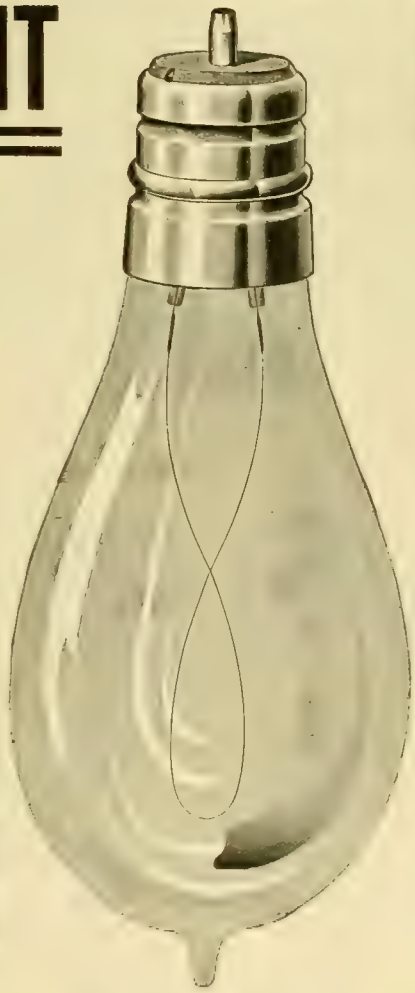

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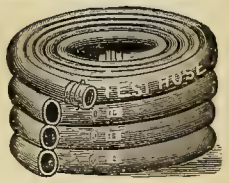

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CEDAR, OCTAGONAL, PINE AND STEEL.

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Western Electrician.

EVERY SATURDAY.

Vol. VIII. CHICAGO, MARCH 7, 1891. No. 10

Myron A. Knapp.

The remarkable enterprise and perseverance displayed in the promotion and conduct of electrical enterprises has frequently been commented upon, and it is generally acknowledged that the position which electricity occupies in the affairs of to-day is due largely to this excellent business management. The energetic men who have guided electrical projects with so much skill and success have been attracted from other fields of commercial activity by the promising outlook in electrical manufactures. They are men of sagacity, as well as energy and perseverance.

Among those who have occupied a conspicuous position in this line in the West is Myron A. Knapp, of whom an excellent portrait is herewith presented. Mr. Knapp was born in Racine, Wis., and received his education at Racine college. He is thirty-six years of age, and is at the head of one of the most important electrical concerns in Chicago. His experience in the electrical field has extended over a period of only about eight years.

Mr. Knapp's first business experience was gained in Racine where he was associated with his father, a lumber dealer. He was also interested in steamboating. He determined, however, to seek a wider field of operation, and decided to make Chicago his home. He soon became interested in the Railway Telegraph Supply company, at that time a small concern at the corner of Fulton and Union streets. Under Mr. Knapp's management the company's business increased rapidly, but as its operations were necessarily limited, Mr. Knapp decided to change the entire policy of the concern. After buying up the stock, and thus securing a valuable plant as a basis, he established the Knapp Electrical Works. The headquarters were changed to Franklin street, and the field of operations again enlarged until it included every branch of the electrical business. Mr. Knapp also established a factory which has kept pace with the other departments, and to-day gives employment to ninety men. The entire building at 54 and 56 Franklin street, the present headquarters, is occupied by the Knapp Electrical Works, and this entire establishment is conducted under the personal supervision of Mr. Knapp. Despite the pressure of business upon his time Mr. Knapp has found time to devote to social intercourse, and he is one of the most popular men in the business. He is a member of the Chicago Electric club, and the same energy which has won his business standing, has characterized his connection with club matters. As a member of the Board of Managers, he has always exhibited a lively interest in the welfare and good standing of the club, and is one of the most active workers. His associate rivals in business agree that his success is well earned.

MYRON A. KNAPP.

An agreement was signed recently for the incorporation of the St. Louis Underground Service company, with a capital stock of $1,000,000. This company will succeed to the property and franchise of the National Subway company, and will immediately organize for business. The purposes for which the company is formed are to lay out, maintain and operate lines of subway for the purpose of carrying electric wires: also, to construct and operate mains and conductors for the distribution of substances for fuel and illuminating purposes, or both.

Brotherhood of Electrical Mechanics.

About seven or eight months ago a number of skilled mechanics engaged in electrical work organized a benevolent association at Chicago. This society was named the Brotherhood of Electrical Mechanics. It now has a membership of nearly 250 and a hall of its own at 94 Dearborn street, Chicago. Two meetings are held every month to enable the members to listen to lectures delivered by outsiders whose opinions are entitled to respect, or papers prepared by their own members. Beside these gatherings for instruction two sociables are given each month. On Feb. 21st the organization gave its first party at the hall on the corner of Monroe and Peoria streets. One of the most attractive features of the occasion was a creditable display of electrical appliances made by a number of Chicago companies. Incandescent lights, with colored globes, so arranged that the appearance of changing the color of the lights could be given, excited admiration. Then there was a big electric annunciator by which the name of the next dance was shown on a card by pressing a button. The use of electrical terms made fun for those who read the programmes. The visitors received the impression that the members of the brotherhood had an intimate acquaintance with the practical application of electricity.

The Brotherhood of Electrical Mechanics has as yet no affiliated branches outside of Chicago, although negotiations are in progress that will doubtless result in the introduction of the brotherhood into several other cities. It is believed to be the first organization of its kind in the country. "Our object," said President Quealy a day or two ago, "is two-fold—beneficiary and educational. We are careful to take in only experienced mechanics who have had at least three years' practical experience. We are connected with no other organization and our society is not a trades union, in the ordinary acceptance of the term. We are unequivocally opposed to strikes, as our constitution shows. We do not believe in interfering between employer and employe and do not presume to act as dictators in the matter of wages. Of course we help one another all we can in the way of getting work and we want to get as good wages as we can, but we act as individuals in these matters and not as an organization. Our membership comprises armature winders, expert linemen, expert telephone men, instrument makers and others of the same general class. We think that we can help one another by 'getting together,' and we propose to extend our brotherhood all over the country."

The officers of the society are: President, C. B. Quealy; vice-president, C. E. Stone; recording secretary, Bert Markle; financial secretary, J. C. Molloy; corresponding secretary, H. M. Hawley; treasurer, O. P. Sells; inside guard, C. A. Roff; outside guard, George Vincent; sergeant-at-arms, William Doughty; statistician, Louis Habel.

Professor Philip Atkinson has already delivered a course of three lectures before the brotherhood and George Cutter and others have promised to make addresses.

Legislation Affecting Telegraph Companies.

A bill has been introduced in the Illinois legislature providing for the taxation of telegraph companies. This bill requires the companies to make annual statements of the length of their lines, and of their wire mileage. Upon these statements it proposes to tax them at the rate of $1 per mile annually, this tax to include only one wire, and in addition to this at the rate of 20 cents per mile for each additional wire. This tax is to be in lieu of all others except upon real estate owned by the companies.

There are many objections to this plan, but the first which suggests itself is that it discriminates against single wire lines. There is more or less complaint that the telegraph service is not extended fast enough, and one of the arguments for a postal telegraph system is that the postoffice department would extend the service to meet the popular demand. The proposed bill would tend to discourage extension of the service to points which for a time might not furnish business enough to be remunerative. This objection might be met in part at least by exempting new lines from taxation for a year, or perhaps two years, or until a second wire is added.

The Water, Light and Power company, of Waco, Texas, has been incorporated with a capital stock of $500,000.

At the convention of the Southwestern Gas association, to be held at San Antonio, Texas, March 10 and 11, the following papers relating to electric lighting will be presented: "Candle Power in Competition with Electric Lighting," by Leonard Gill, Corsicana, Texas; "Electric Lighting in Connection with Gas Lighting: Comparative Prices and Profits of Each," by J. J. Walsh, Paris, Texas. "The Alternating Current," by J. H. Maxon, Waco, Texas.

The Love Electric Conduit System and Car.

The production of a reliable electric conduit system for the street railway is now generally admitted to be one of the most important problems which must be solved before the electric car will find its way to any large extent on to the streets of a number of the large cities of the country.

Among those who thoroughly appreciate this increasing demand for an efficient conduit is the Love Electric Traction company, Chicago. This company is strictly a Chicago enterprise, and was organized with the object of exploiting the system devised by Col. J. C. Love of Philadelphia.

Through the courtesy of General Manager Albert G. Wheeler, the WESTERN ELECTRICIAN is enabled to present a description of the most important features of this system.

Without going into details it may be stated that the Love company has a conduit as shown in Fig. 1, which is built without nut or screw. The conductors are placed in the upper portion of the conduit, and are protected as shown by the flanged lids or covers. The flanges of the covers, it will be noticed, extend down below the conductors. By this construction, the lids are not only strengthened against bending by the passage of heavy teams, but water thrown on top of the conduit and entering the slot, will run down to the bottom of the flange and drop thence to the bottom of the conduit, without any possibility of its striking the conductors. Another advantage of the flanged cover is that it makes the conduit easily accessible without any disturbance of the adjacent pavement. This feature will be appreciated by practical men. By an ingenious device as the car passes along air is to be blown through the conduit with the object of keeping it clean and dry.

The conductors are insulated from the casting, as represented, by means of glass or porcelain blocks. A block is first inserted in the casting, and then a tongue from the conductor is wedged into it.

The car which the Love Electric Traction company proposes to introduce along with its conduit, is shown in Fig. 2. This car is to be driven directly by the motor. In other words, a slow speed motor will be employed and the armature will be connected by means of a rod and crank pins with the wheels of the car. A glance at the illustration will show this construction, which the company claims will make the action of the motor absolutely noiseless. The truck is pivoted at a point in front of its proper center, and the trolley bar is set near to the center pin and front axle of the truck, so as to reduce the side-wear on the trolley bar to a minimum. The motor is set quite a distance from the ground, and is so boxed in as to be easily accessible to the motorneer standing on the trap door above it. By thus elevating the motorneer he is placed in a position to see the track both before and behind the car.

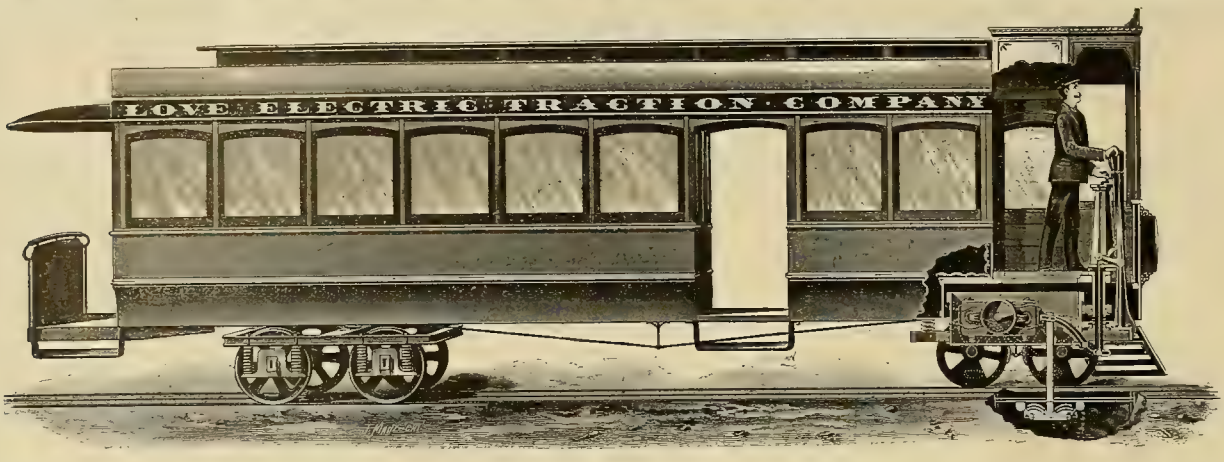


FIG. 2. THE LOVE ELECTRIC CONDUIT SYSTEM AND CAR.

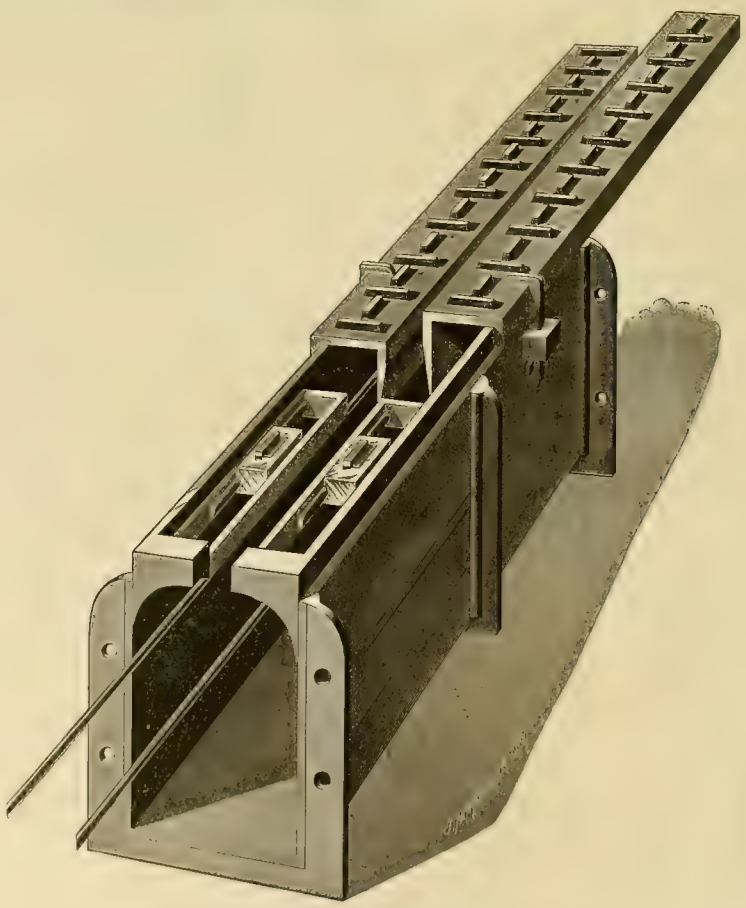


FIG. 1. THE LOVE ELECTRIC CONDUIT SYSTEM AND CAR.

Sulphur Springs, Texas, has advertised for an electric light plant. Bids will be received till April 1st. A correspondent writes that there is a demand for an electric railway in the city.

Electrical Section of the World's Fair.

The subject of buildings for the electrical section of the World's Columbian Exposition occupied the attention of the chief of construction and his associates last week. The designs and specifications submitted by the architects were considered, but no action was taken. Prof. Barrett, chief of the department of electricity, was consulted, and he said the question of buildings could not be satisfactorily decided until an opportunity was afforded prospective exhibitors to signify how much space would be required. There were many more features which should receive careful consideration before the question of buildings was finally decided. At the present time, he said, the architects had no intelligent idea of the requirements of this particular department, and it would require considerable work to gather the necessary information. The architects will consider Prof. Barrett's suggestions, and report to Chief Burnham.

The following communication was received last week by Director General Davis from J. P. Barrett, chief of the electrical department:

I have the honor to submit herewith for your consideration an estimate for lighting Jackson Park, Midway Plaisance and the Lake Front.

To light the various buildings located at Jackson Park and Midway Plaisance will require 3,500 2,000 candle power arc lights, and 5,500 16 candle power incandescent lights.

To light the open space at Jackson Park and Midway Plaisance will require 1,000 2,000 candle power lights.

The cost of subways connecting all the buildings with the power house as located by the architect-in-chief, erection of lamp posts and towers, wire, labor, dynamos, engines, boilers and all the necessary equipment will require a total expenditure of $1,650,000. Without knowing exactly the number of buildings that will be placed on the Lake Front and the size of the same, I can only approximately estimate the number of lights there, but from what information I am able to gather I think an appropriation of $320,000 will provide light for the buildings, grounds and spectacular displays that will be given there. The idea of transmitting power from Jackson Park to light the Lake Front seems to me a costly one and not advisable. The estimate that I have made above is ample to locate a station at the north end of the Lake Front, and will be decidedly more economical.

The above estimate will be subject to considerable salvage; I have based it upon the extreme limit; the great bulk of this expenditure can be rebated by the sale and trade of this apparatus after the fair has terminated. I have not entered into the details of the expense of the railroad and transportation upon the grounds, as I believe this feature will not only be self sustaining but a source of revenue; therefore, the only expense in that direction will be the employment of inspectors to see that the plans are complied with.

The transmission of power for the purpose of operating all classes of light running machines will no doubt be quite generally used, and will thereby save the erection of a large amount of shafting. No intelligent estimate of the electrical energy necessary for this service can be made at present, or until some idea can be had of the mechanical power required by the exhibitors.

The establishment of a police and fire department in the fair ground will no doubt be one of the features of the fair, and will entail the necessary electrical equipment for these departments. This branch of the service will require constant attention, and should be one of the first installations made in the fair grounds, as a protective measure. I estimate that four operators will be ample force to operate this branch night and day. A system of 50 police, and 50 fire alarm boxes, with the necessary central office instruments and local telephone exchange, connected with the Chicago police and fire departments and Chicago telephone exchange, will cost, approximately, $30,000.

To secure the co-operation and assistance of the electrical papers throughout the world is a matter of great importance. The electrical trade papers, both in this country and abroad, are enterprising, and have on their staff men of wide acquaintance and much general information. It is desirable to get their assistance, and at the same time

have them interested in spreading information and securing information for the use of this department. This I anticipate will come under the duties of the Department of Publicity, but I desire to especially direct your attention to it. I think an appropriation of $20,000 per annum should be made for this purpose. The necessity for the immediate organization of the Department of Electricity is apparent, and the employment of a secretary, clerk and stenographer, as well as furnishing the necessary stationery, office equipment, etc., is absolutely imperative. The following is an estimate of the salaries, maintenance of police and fire telegraph system, maintenance of electric lights, traveling and incidental expenses, stationery, postage, etc.

Chief of department, 2½ years, $5,000 per annum	$ 12,500 00
Principal assistant, 2 years, $4,000 per annum	8,000.00
Assistant, 2½ years, $2,000 per annum	5,000.00
Secretary, 2½ years, $2,000 per annum	5,000.00
Two clerks, 2 years, $1,000 per annum	4,000 00
Stenographer, 2½ years, $900 per annum	2,250.00
Chief inspector, 2½ years, $1,500 per annum	3,750.00
Ten inspectors. 1½ years, $1,000 per annum	15 000.00
Four operators, 2 years, $1,000 per annum	8,000.00
Maintenance of fire and police telegraph	5,000.00
Maintenance of 5,400 arc lights and 55,000 incandescent lights, including coal, oil, waste, carbons, globes, help, etc	714,000.00
Stationery, postage, etc	5,000.00
Traveling and incidental expenses	10,000.00
	$ 797,500.00

RECAPITULATION.

Lighting Jackson Park and Midway Plaisance	$1,650,000.00
Lighting Lake Front	310,000.00
Fire and police telegraph	30,000.00
Salaries, maintenance, etc	797,500.00
	$2,787,500.00

At the last meeting of the directors of the World's Columbian Exposition the special committee on budget presented its report. The net expenditures for grounds, buildings, and transportation were estimated at $15,000,000. The committee had this to say in regard to the location of the entire electrical exhibition at Jackson Park:

"Your committee believes that electrical displays can be presented with better effect and to the greater satisfaction of the public in a building designed for electrical exhibits at Jackson Park than upon the contracted space on the Lake Front. This view of the matter is shared by Col. Clowry, chairman of the committee on electrical exhibits, and by other good authorities. Hence the estimates for buildings can be lessened $250,000 in this direction. The director-general estimates over $300,000 for electric plant and lighting on the Lake Front."

J. Allan Hornsby has been appointed secretary of the Electrical Bureau by Prof. Barrett. Mr. Hornsby has a wide acquaintance in the electrical fraternity, who will congratulate him on his appointment.

English Portable Electric Light Plant.

The cut presented herewith illustrates a portable electric light plant made by Laurence, Scott & Co., of Norwich, England. This plant, Fig. 1, has recently been completed, and is capable of supplying 150 lamps of 16 candle power each. The boiler is of the upright type, and is made of Siemens' steel plates. It has 48 tubes, and is to operate at a pressure of 120 pounds per square inch.

The engine, says the London *Electric Plant*, is compounded with cylinders respectively 5½ inch and 9 inch diameter and 6 inch stroke, with a special arrangement of piston valves by which a single valve is made to serve for two cylinders, as well as for a connection between the two. Two relief valves are fitted to each cylinder in such a position that the motion of the valves can be examined by unscrewing one of them, which is a great convenience in setting up and overhauling the engine.

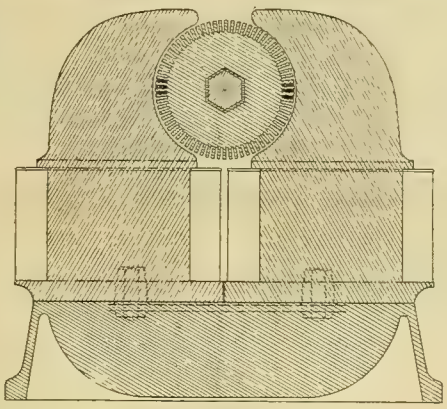


FIG. 2. ENGLISH PORTABLE ELECTRIC LIGHT PLANT.

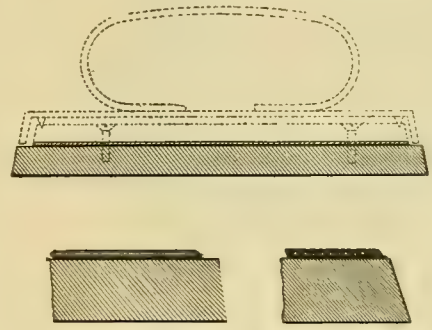


FIG. 2. CARPENTER'S IMPROVED ELECTRICAL FLAT-IRON.

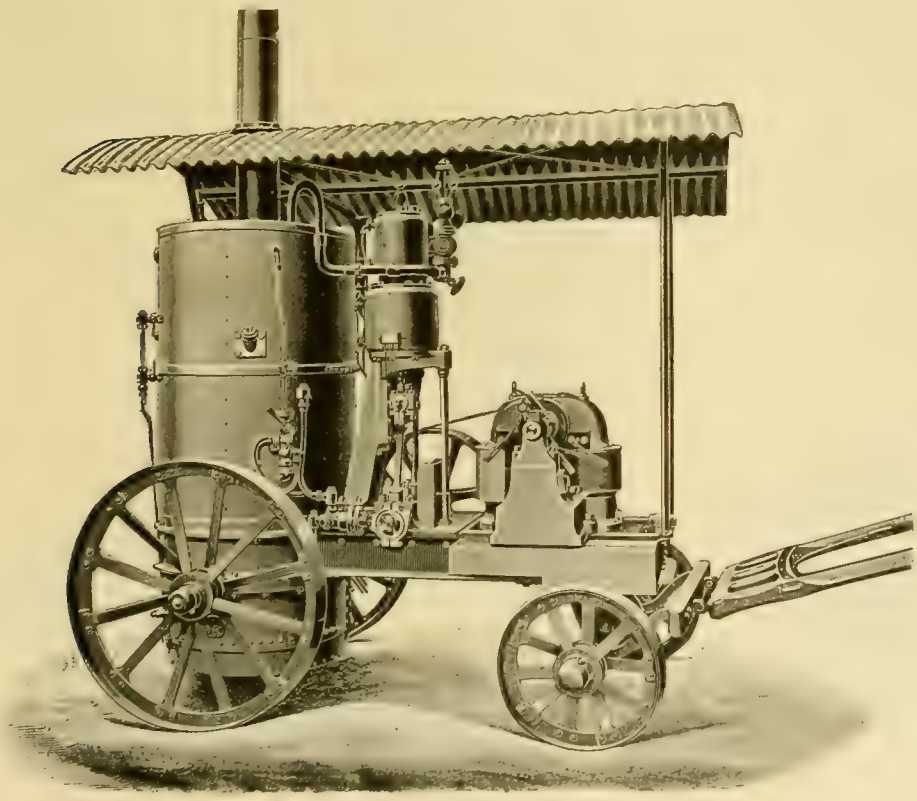


FIG. 1. ENGLISH PORTABLE ELECTRIC LIGHT PLANT.

The dynamo is compound-wound, with special screw-tightening gear for adjusting the belt while running, and it is driven by a specially thin and wide belt. This machine was wound to generate 90 amperes at 110 volts when running at 800 revolutions.

Fig. 2 shows a section through the armature and field magnets, and particularly the construction of the armature core.

This plant was tested with an eighteen hours' continuous run; twelve hours at full load and directly after six hours at 25 per cent. above full load. The run was, it is asserted, perfectly satisfactory.

Carpenter's Improved Electrical Flat-Iron.

Most of the readers of the WESTERN ELECTRICIAN are familar with the construction of the electric heating apparatus designed by Chas. E. Carpenter of Minneapolis, Minn. Since the last description of this heater, however, certain improvements worthy of mention have been made.

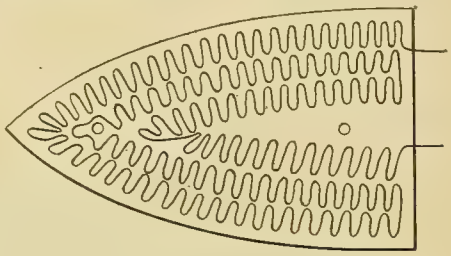
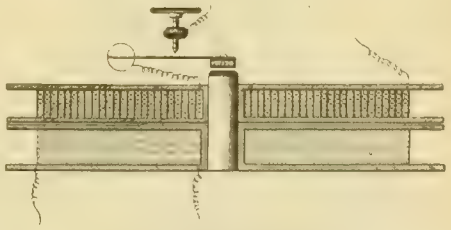


FIG. 1. CARPENTER'S IMPROVED ELECTRICAL FLAT-IRON.

In the flat-iron, as formerly arranged, Fig. 1, the resistance, which was insulated from the surface plate by a sheet of mica, was held in place by being attached to an asbestos card, and confined against the plate under pressure. The recent improvement, illustrated in Fig 2, consists in having the resistance, or heater proper, permanently attached to, but insulated from, the plate to be heated, by an adhesive material which will withstand the heat without deterioration. This adhesive material is stated by Mr. Carpenter to be ordinary enamel, such as is applied generally in a plastic condition to the surface of various metals, and which, after being fused and cooled coats the metal with a hard glazed surface similar in its nature to glass. It is asserted that in practice the best results are obtained by first coating the back of the plate with the insulating material, and then laying the resistance upon this enamel, and applying a second or as many additional coats of enamel over the resistance as may be desirable. The first coat applied to the plate serves to insulate the resistance from it, and also constitutes a base for the application of the remaining coats.

Brown's Induction Coil.

The accompanying cut illustrates a form of induction coil invented by F. H. Brown, Chicago. The special features of the device which will be readily understood after a glance at the illustration, are the method of winding each coil and the relative disposition of the primary and secondary coils. Mr. Brown asserts that by introducing a strip of thin Russia sheet iron between each layer of the primary coil as it is wound, as shown, on the flat spools, a coil of great efficiency is obtained.



BROWN'S INDUCTION COIL.

The Western isolated lighting department of the Thomson-Houston Electric company reports the following recent sales: Calumet Distilling company, New Chicago, Ill., 200 light incandescent plant, increase; Bradner Smith & Co., Chicago, 20 arc light plant, increase; Woodcock & Loring, for the Clifton House, Chicago, 12 light arc plant; Liss & Rickeman, 75 North Clark street, Chicago, 120 light incandescent plant; D. B. Fisk & Co., Wabash avenue and Washington street, 35 arc light plant and 250 light incandescent plant.

The Westinghouse Multipolar Slow Speed Electric Street Car Motor.

The railway department of the Westinghouse Electric & Manufacturing company has recently completed an entirely new electric street railway motor. This apparatus has a slow speed armature and is of the multipolar type. As will be noticed from the accompanying illustrations, the apparatus is a four-pole motor with a single reduction gear. It consists of three parts only: the frame and a semi-divided cylinder. The new machine has a cast-iron frame, similar to the one employed on the ordinary type of Westinghouse street railway motor.

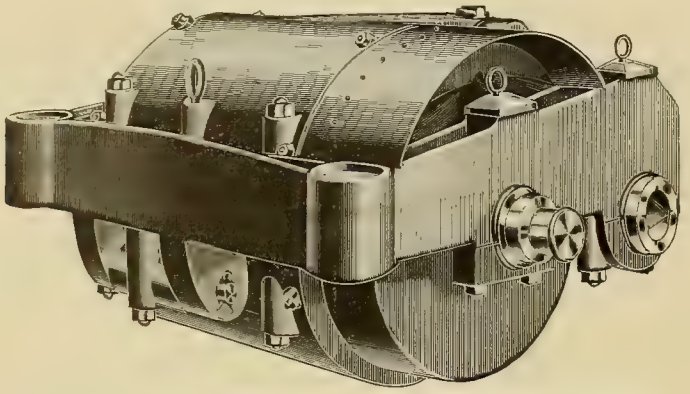


FIG. 1. WESTINGHOUSE MULTIPOLAR SLOW SPEED ELECTRIC STREET CAR MOTOR.

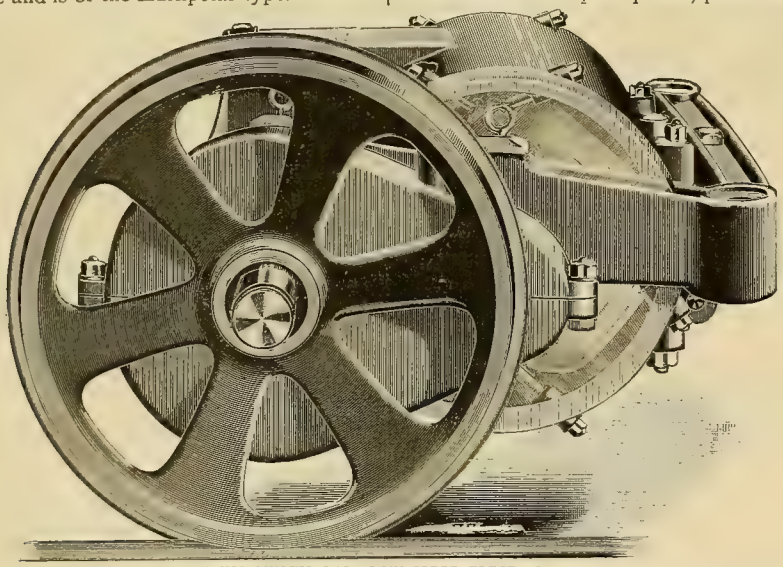


FIG. 2. WESTINGHOUSE MULTIPOLAR SLOW SPEED ELECTRIC STREET CAR MOTOR.

The motor is cylindrical in shape, and is divided into two parts. Each part of the cylinder is hinged to the frame in a manner so as to afford a workman an easy access to the apparatus. By unscrewing a few bolts the field coils and the armature can easily be reached. Each half contains two pole pieces, protruding radially toward the armature. The field coils are slipped over the poles and are held in position, and at the same time protected, by a brass cap. Any one of the fields can be removed without interfering with any other part of the apparatus. The field coils are wound with well insulated wire of large carrying capacity. By this construction the motor can be handled by one man alone, who may lift the fields back, remove the field coils, take out the armature, etc., without interfering with any other part of the machine. While this manipulation of the different parts of the motor is being conducted it is not necessary to remove the motor from the car truck.

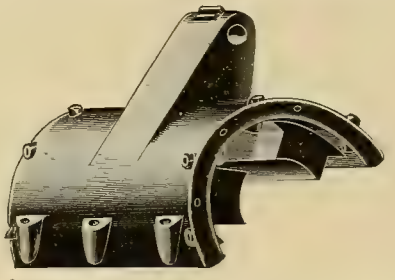


FIG. 6. WESTINGHOUSE MULTIPOLAR SLOW SPEED ELECTRIC STREET CAR MOTOR.

The armature is of the drum type. The core is built up of laminated iron plates, so notched that when the core is completed the wire is contained in slots. By this construction the wires of the armature are surrounded by iron. The armature shaft is tapered at the ends for mounting the pinion, so that lost motion may be easily taken up.

The commutator has been especially designed for street car work, and is so constructed, it is stated, that heating will not produce unequal expansion, which might loosen the commutator bars.

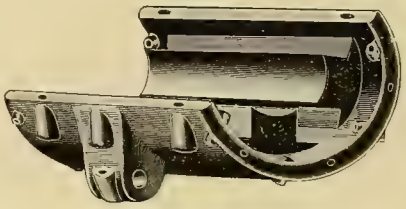
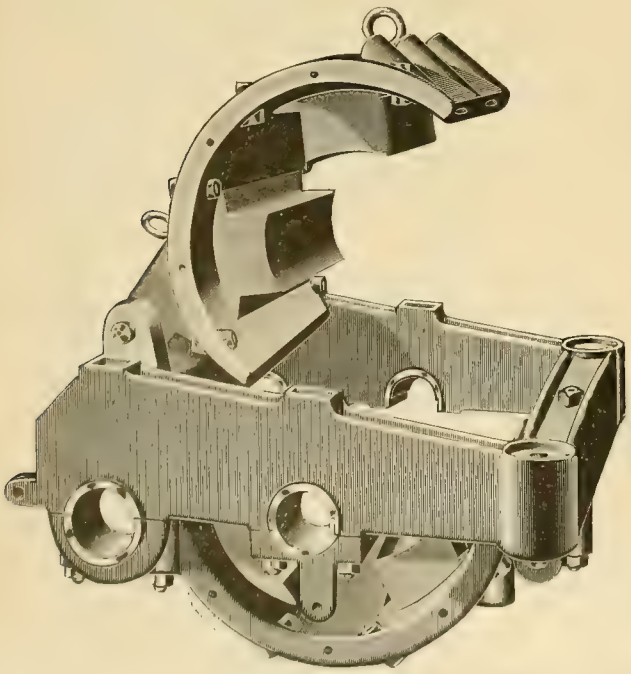
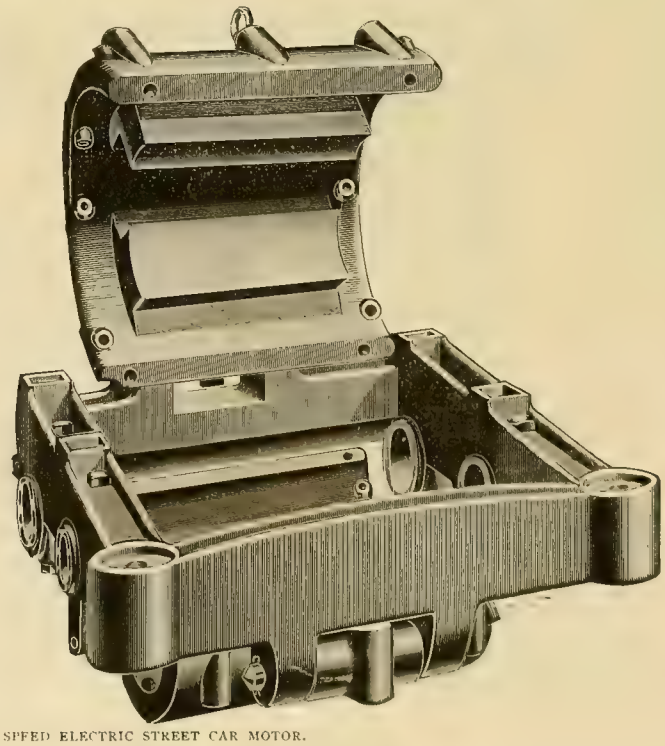


FIG. 7. WESTINGHOUSE MULTIPOLAR SLOW SPEED ELECTRIC STREET CAR MOTOR.

The brush holding device consists of a square oak holder attached to the side of the motor frame and carrying the brush-holder proper. The carbon brushes are placed in a sliding frame and pressed against the commutator by a pair of springs.

It will be seen that the motor is well protected against water from the outside; in fact the apparatus can be completely shut in. The cast iron box, filled partly with grease, surrounding the gearing, not only prevents a great deal of noise, but also adds greatly to the durability of the inclosed parts.





FIGS. 3 AND 4 WESTINGHOUSE MULTIPOLAR SLOW SPEED ELECTRIC STREET CAR MOTOR.

In order to thoroughly appreciate all the mechanical and electrical features of this new Westinghouse motor it will be necessary for the reader to study closely the cuts. Fig. 1 is a diagonal view of the motor, with its lower half

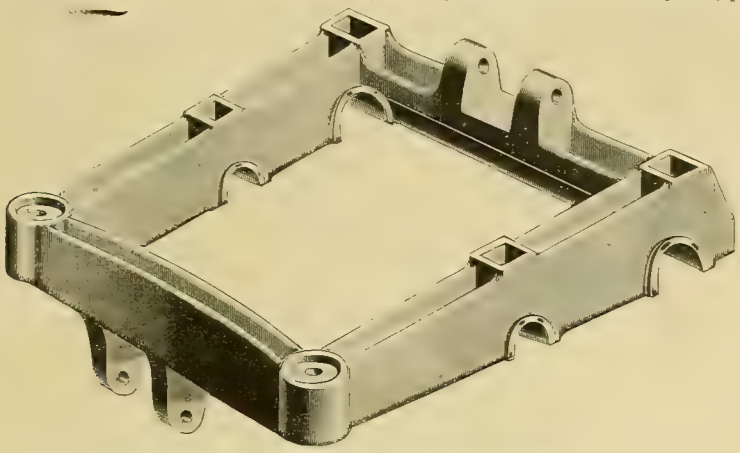
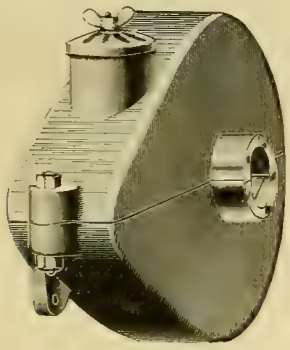
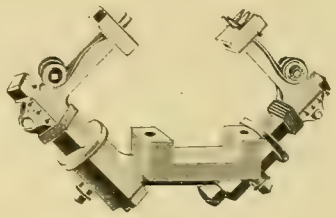


FIG. 5. WESTINGHOUSE MULTIPOLAR SLOW SPEED ELECTRIC STREET CAR MOTOR.

completely inclosed, and its upper half and commutator protected against water leaking through the car floor by a removable umbrella casing. Fig. 2 is a side view of the motor mounted upon a car axle with the gear casing





FIGS. 8, 9, 10. WESTINGHOUSE MULTIPOLAR SLOW SPEED ELECTRIC STREET CAR MOTOR.

in place. A glimpse of the fields through a transparent side plate is also given. Fig. 3 is a side view of the frame and field castings, showing the upper half of the cylinder raised. It may be stated that it is never necessary to remove the frame or field castings from the truck, as by swinging the upper or lower half of the motor the field coils can be readily removed or the armature lowered.

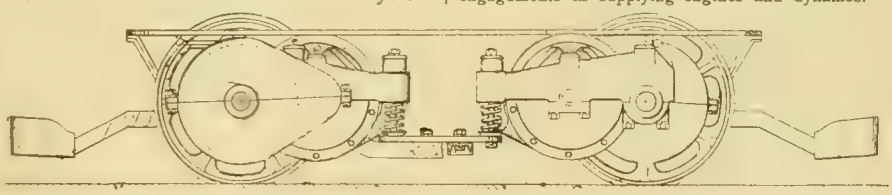
In Fig. 4 is given a front view of the frame and the field castings with the upper half of the cylinder raised for removing the field coils or an inspection of the armature.

Figs. 5, 6, 7 and 8 represent respectively the motor frame for 3 feet 6 inch gauge, the upper field casting, the lower field casting, and the gear casing. Fig. 9 is a field coil. All four field coils are alike, and are constructed so as to be readily slipped over the field castings. Fig. 10 shows the brush holder, which is hung below the commutator so as to leave the upper portion of the commutator exposed for cleaning. A plan and elevation of the motors on a truck, one being encased and the other open, is shown in Fig. 11. The single reduction gearing is well represented at the lower left hand corner of the plan view in this cut.

Cicero and Proviso Electric Road, Chicago.

The formal opening of the Cicero & Proviso Electric railway was held last week. About 200 business men of Chicago took a special train to the beautiful suburban district through which the new road extends. They assembled at the power house and examined the equipment with interest. The plant has already been illustrated and described in the WESTERN ELECTRICIAN. A ride over the line in the handsome new electric cars afforded the visitors ample opportunity to inspect the handsome residential property of the section, and display the numerous advantages of electric traction. After a ride through Moreland, Linden Park, Austin, Ridgeland and Oak Park, the visitors were invited to partake of a lunch at Ridgeland hall. Music was furnished by a mandolin orchestra, and speeches were made by representatives of the company and the community which the railway will serve. E. W. Lyman, president of the town board of Cicero, ventured the statement that the electric road meant an advance of $10 to $20 a front foot in the valuation of property in that town. "That is only one of the advantages of this improvement," he said.

E. A. Cummings, in a brief speech, called attention to the fact that the new enterprise would increase the possibilities of the people in the suburbs becoming acquainted with each other. This social feature of the new system



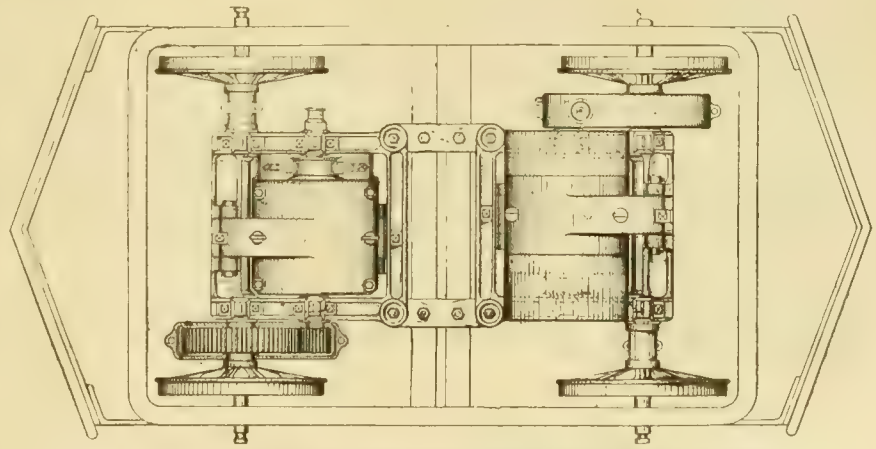


FIG. 11. WESTINGHOUSE MULTIPOLAR SLOW SPEED ELECTRIC STREET CAR MOTOR.

was one of its strongest points, he said, and one which the ladies considered the most important.

Prof. J. P. Barrett, city electrician of Chicago, was one of the speakers. He dwelt upon the possibilities of electric railways, and said he anticipated great advancements in this line. He believed a system would soon be in practical operation which would not conflict with the city ordinances of Chicago. Prof. Barrett was congratulated upon his recent appointment to the position of Chief of the Electrical Bureau of the World's Fair.

The company announces that it will extend its system immediately. At present there are 12 cars on the line and 6 more will be added in the spring. Then there will be several new lines established in connection with those now in operation, and additional cars will be required for these. The capacity of the power plant will be doubled in the spring.

The officers of the road are: D. J. Kennedy, president; Taylor A. Snow, vice-president; Frank E. Ballard, secretary; and George Eckhart, treasurer. The directory is composed of the following men: E.A. Cummings, H. G. Foreman, J. J. McCarthy, R. W. Hyman Jr., H. S. Towle, James Darlow, D. J. Kennedy, Taylor A. Snow, F. E. Ballard, and George Eckhart. The capital stock of the company, which was organized in February, 1889, is $1,000,000, having been increased from $250,000.

A Good Word for Electric Railways.

The New York *Times* recently contained a dispatch from Cleveland discussing the operations of the electric car system in that city and Boston. The correspondent gave a most doleful story, representing the electric system as a nuisance, a menace and a failure. Commenting on this dispatch the Rochester, N. Y., *Herald* says editorially: "Rochester has had two lines in full operation for weeks. They are among the most important routes in the city. They have been running during the worst season, encountering heavy snow and sleet storms and with inadequate equipment, so far as the motive power is concerned, on account of the failure of manufacturers to meet their engagements in supplying engines and dynamos. Yet with some drawbacks that obviously will be remedied as soon as the plant is completed the electric system here has been a grand success. People living on the lines already equipped would no sooner think of going back to the former slow and dirty horse car system than they would think of substituting the old stage coach for the modern vestibuled railroad train. In a two miles run on the Lake avenue route there is a difference of from eight to twelve minutes in favor of the electric cars."

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F. L. PERRY, - - - - - - - - - - - }
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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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IT is gratifying to note that the newly organized Brotherhood of Electrical Mechanics starts out with the distinct avowal that it will have nothing to do with strikes and in no way interfere between employer and employe. It is stated that the object of the organization is of a two-fold character, its aim being to provide educational advantages for its members and also to place at their disposal beneficiary and social privileges. If the new brotherhood directs its energies entirely in the manner indicated, it is likely to be commended and assisted by the electric companies. The only obstacle to its rapid growth, probably, will be the more radical element among those whom it seeks to unite—men who would prefer to band themselves together in a trades union rather than affiliate with an organization of the pacific character of the new association.

Those experimenting with the view of producing an efficient arc lamp for constant potential circuits will find little consolation in Prof. Elihu Thomson's paper read at the Providence Convention and presented in the last issue of the WESTERN ELECTRICIAN. The great demand for an "incandescent" arc lamp has led many inventors to spend considerable time at this work. But from what Prof. Thomson says, a great deal of useless experimenting has been carried on "with the vain endeavor of getting rid of the resistance or choking coil." If, then, extra resistance, according to Prof. Thomson, must be used with the constant potential arc lamp, and, therefore, a loss of power experienced, it would seem as though the arc light companies need have no fear of damaging competition from incandescent lighting companies which have ventured to encroach upon a field not strictly their own.

A BIT of interesting news to telegraph, telephone and overhead electric railway men, is presented in another column. It seems that Judge Kinne of Ann Arbor, Mich., has decided that "in the present state of electric art, poles and wires are essential elements in the system of electric railways," and that "private convenience and interests must sometimes yield to public good." But he thinks it is different, however, in the case of the telegraph and telephone systems. These are, to quote the judge's words, "foreign to the natural and legitimate use of public highways." Property holders may do all in their power to retard the progress of the electric railway, but it seems as though such a slight disfigurement of the roadway should not stand in the way of public improvement. Heretofore, even the telegraph and telephone companies have maintained that they had a right to occupy the streets, and that electric light and railway companies could not legally disturb them. The general verdict seems to be opposed to the telephone and telegraph companies in this matter. It would be much more satisfactory if the interested parties would get together and adjust their grievances amicably.

AT the last convention of the National Electric Light association at Providence considerable attention was given the subject of adverse legislation. The committee having in charge the collection of information on this subject reported that several bills had been introduced in state legislatures containing provisions that were not only unfavorable to the electrical interests of the country but in many cases practically prohibited electrical work. The necessity of organized opposition to the encroachments of legislatures was impressed upon the delegates, and it was agreed that the work begun about a year ago in several states in the matter of local organizations should be continued. Additional reasons for taking up this work at once are furnished by the reports from several state legislatures, now in session, where bills are under consideration. Not only have the electric lighting interests been assailed, but the telegraph, telephone and electric railway are coming in for a portion of the attention of lawmakers.

It is a pleasure to note the fact, however, that in California the rights of the electric railway have been recognized by both houses of the legislature despite the desperate fight made on the bill by the opponents of electric traction. Some of the bills introduced in the state legislatures would excite merriment were it not for the fact that they assail important industrial interests, and if enacted would seriously affect the departments at which they are aimed. The provisions of these bills support the statement that the men who prepare and pass them are densely ignorant of the work in hand. It is the province of the associations formed in the several states to protect the interests of the electrical companies against the blind and senseless attacks of such men.

AMERICAN electricians are prone to belittle the progress made by the English in the practical application of electricity. In fact it is by no means a rare thing to hear expressions which give the impression that the English electrical engineer, speaking generally, while progressing theoretically fails to produce practical results of any importance. Americans have come to accept with complacency the distinction generally accorded them of being far in advance in the matter of practical applications of electricity, and many assume that all the great inventions have been made in this country. As practical men, however, we should not lose sight of the fact that self-satisfaction may lead to inactivity and that on this account, in one field at least, our English cousins may capture the laurels. The readers of the WESTERN ELECTRICIAN will remember that in the last issue reference was made, in one of the addresses delivered at the convention, to the remarkable success of the City & South London railway in England. Those who read a description of this road, which was presented in a previous issue, will doubtless remember this statement: "The armatures of the locomotives are constructed so that the shaft of the armature is the axle of the locomotive. In this way all intermediate gear and all reciprocating parts are entirely obviated." Also, that the motors were capable of "running up to 25 or 26 miles per hour." With these statements in mind and Mr. Sprague's reference to the successful working of the road, one begins to wonder whether the American electrician is not the one who is a little behind. Ever since the electric railway began to lose its novelty, the cry has been that the electric car was noisy, and that the noise was due to the gearing. Of late efforts have been made by our manufacturers to do away with the intermediate gearing. One of the most recent steps in this direction is presented in this issue. But with all this, if accounts be true, are we not still behind the English in our attempts to drive our cars with an armature on the axle? Perhaps our English contemporary that published the description of the London system may have been in error in making the statement quoted. We hope not, for if the English can do it we can, and, perhaps, signs of progress on the other side of the water may lead to a more speedy death of the "noisy gearing."

A STENOGRAPHIC report of the discussion of the subject of "Rapid Transit in Cities" before the New York Electric Club last week is presented elsewhere in this issue. The possibilities of electric traction in the solution of this great problem were ably set forth by prominent engineers. Frank J. Sprague, who has made a special study of the requirements of New York city, made an interesting address. He expressed the conviction that the final solution of the problem would be presented by electrical engineers. There are many obstacles, it is true, to overcome, yet they are not as formidable as those which the pioneers in the electric railway contended with and finally overcame, in developing the present system of surface roads. Mr. Sprague is satisfied that in underground construction alone can permanent relief be secured to New York, and in this view he is supported by a majority of the expert engineers, both electrical and mechanical, who have given the subject special study.

Mr. Sprague still advocates the establishment of an electric line between New York and Philadelphia. When this proposition was first made public it attracted considerable attention on account of the novelty of the project, but was not seriously considered by the so-called "practical men" who might be expected to furnish the funds for the equipment. The advancement that has been made in the line of electric traction, however, has caused the most skeptical to hesitate before condemning any proposition, no matter how improbable it may look, in the light of the achievements of the present day. Yet even in these does Mr. Sprague find material in support of his proposition. The Minneapolis-St. Paul system of electric roads connecting the Twin Cities is the first practical step in this direction. True, the distance between Minneapolis and St. Paul is much less than between New York and Philadelphia, but it should also be remembered that there were many difficulties attending the installation of the first roads which seemed to preclude the possibility of making them commercially successful. Yet the problem was solved, and Mr. Sprague hopes to see the question of rapid transit for New York and communication with Philadelphia decided like the others in favor of electricity.

Other speakers on this subject, including Edward Weston, were equally positive in their statements that the permanent solution of the rapid transit question for New York and other large cities would be the adoption of the electrical system.

Dynamo and Steam Turbine.

The steam turbine dynamos illustrated in the cuts presented herewith are described by the London *Electrical Review* substantially as follows:

The chief characteristic of the turbo electric generator is that the motor part of the combination consists of a "parallel flow" compound steam turbine, revolving at an extremely high rate of speed, and coupled directly to a dynamo of special construction.

Fig. 1 represents a 35-unit steam turbine dynamo whose speed is 4,500 revolutions per minute. This machine is of ordinary construction, with a Gramme armature. The speed is sufficient to enable the dynamo to develop an unusually large output for its size. The whole plant is extremely light and compact.

Fig. 2 shows a 75-unit steam turbine alternator. The speed is 5,000 revolutions per minute.

It may be mentioned that four turbo alternators of 75 units each have been generating current for the Newcastle & District Electric Lighting company, England, for the last twelve months, during which time, it is stated, there has been no hitch or stoppage, and the service has been exceptionally steady. Additional plants of the steam turbine alternator type of 75 units each, as illustrated, are now being added to meet the increasing demand for lights. The present output amounts to 8,500 10-candle power glow lamps.

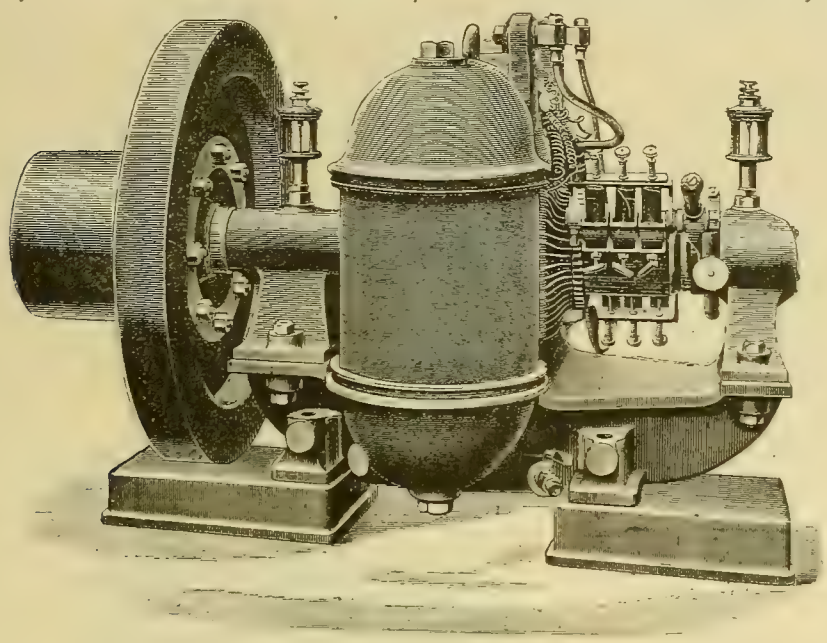


FIG. 1. DYNAMO AND STEAM TURBINE.

Chicago Electric Club.

At last Monday's meeting of the Chicago Electric club Vice-president Kempt occupied the chair in the absence of President Beach. Chief Electrician Barrett of the World's Columbian Exposition, sent in a letter stating that he had been asked to appoint "an electrician competent to undertake an advisory duty on the staff of the chief of construction of the exposition." It was also stated that the occupant of this position would be assigned to duty in the office of the architect, and that his salary would be $2,000. Professor Barrett concluded by paying a graceful compliment to the club and asking it to nominate three or five electricians from whom he could make the appointment.

After the letter had been read the club proceeded to make the requested recommendations, the president being authorized to send the following communication to Prof. Barrett:

I have the honor to report that at a regular meeting of the Chicago Electric club held Monday, March 2, 1891, your communication requesting the nomination of three or five electricians from whom to select an electrician to act in an advisory capacity in the office of the architect was read, and the following nominations were unanimously made: Geo. Cutter, Fred Sargent, F. H. Soden, Thos. G. Grier, Geo. H. Bliss. The club desires to thank you for your courtesy in asking its co-operation in this matter.

The Brush Electric Light and Power company of Columbus, Ga., is installing additional machinery.

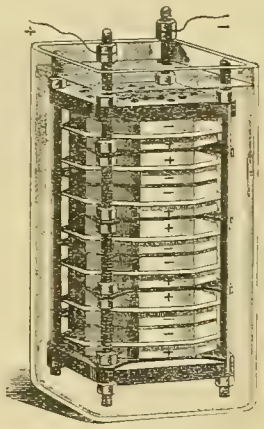
Prof. Barrett and Overhead Electric Railway Wires in Chicago.

When Prof. John P. Barrett of Chicago was in St. Louis recently he was subjected to cross-examination by a local interviewer. His mission in St. Louis was to examine the street lighting system and the street railway systems. The electric light construction was commended, but the professor has this to say in reference to overhead electric railway circuits:

"I am satisfied that street cars can be propelled by electricity conveyed in conduits, and I shall recommend that Chicago say to all applicants for such franchises: 'When you find a means of going underground you can have your franchise, and not before.' They'll find it soon enough. The fact is, that the underground system costs more money, and hence street railroad men are slow to adopt it. But they've got to come to it in Chicago. We're getting all other kinds of wires off our streets very fast—fire and police, electric lighting, Western Union and telephone—and placing them in conduits; and the street railroad companies must get their electric power out of a conduit. My idea would be to lay the wire a good deal as the cable rope is laid in a circular conduit, the shape of which would conform to the casting of the yoke. The trolley-bar could run in a slot, just as the grip does now, and the motor man can pick it up or let go of it in much the same manner. The thing is perfectly practical. All that is needed is adequate provision for drainage."

The Atlas Accumulator.

The Atlas Accumulator, presented by M. R. V. Picou to the Societe Internationale des Electriciens at its last sitting, is the result of the combined endeavors of Carl Hering of Philadelphia, Abdank Abakanowicz, D'Arsonval and Picou. The accumulator, according to the London *Electrical Review*, is composed, as shown in the accompanying figure, of a series of positive and negative elements placed horizontally and alternately one upon the other. Each of these plates is formed of two rectangular blocks with rounded corners, and is pierced with a great number of holes. These blocks of peroxide of lead present considerable solidity, notwithstanding their porosity. The current is brought to the blocks of active material by plates of lead, which are fixed alternately on opposite sides of two rods of antimony-lead alloy. These rods are provided with screw threads and nuts which keep in position the corners of the plates, holding them firmly, and insuring good contacts. A thin sheet of perforated celluloid separates



ATLAS ACCUMULATOR.

plates of contrary natures. Two conducting bolts of antimony-lead alloy and two ebonite bolts insure the rigidity of the whole apparatus by exercising a pressure on two perforated plates of ebonite placed at the top and bottom of the accumulator.

By this arrangement, the inventors state, there is employed for the positive and negative electrodes a composition which is homogeneous, and which conducts throughout its mass. The mounting, moreover, gives fixity to the whole, and facilitates inspection, and, when necessary, the renewal of the plates. The most characteristic point claimed for this new type of accumulator is its specific lightness. From it there can be obtained, it is claimed, from 12 to 20 ampere-hours per kilogramme of plates, according to the rate of discharge adopted. The rate of discharge varies with the thickness of the active blocks. The thick blocks are fourteen millimetres thick, and are suitable for outputs of less than one ampere per kilogramme. The thin blocks are only eight millimetres thick, and the output can then amount to two, or even three amperes, per kilogramme.

The shunt dynamos generally used for industrial purposes being calculated to furnish a constant difference of potential, are well adapted to the system of charging advocated by M. Picou.

Electrical Engineering.

The inducements offered by the profession of electrical engineering are drawing each year an increasing number of young men into technical study of the subject. Electrical industry has two widely different phases, practical and technical. Fifteen years ago so little was known of the practical application of electricity that a quick, inventive mind, with no more technical training than might be gained by the experience of a telegraph office, could strike out in new lines of progress with every prospect of success. To-day good work cannot be done without studying and profiting by the results of that fifteen years of marvelous development. He who starts to-day with the training that would have meant success then, will probably meet dismal failure now. Therefore, in taking up the study of electrical engineering, the more careful and thorough work you do, the better the chance in the future. Do not be deluded into the idea that you should "learn practical electricity in the workshop." You can learn more that will be of service to you by a year's careful work in a good laboratory than in five years in an electrical manufactory. Do not expect to leave the laboratory with an intimate knowledge of any electrical system; you will not have it, but you will have acquired what is of vastly greater value, that firm grasp of the general principles that will enable you to seize the details of any system with a rapidity that will surprise you.—*Mining and Scientific Press.*

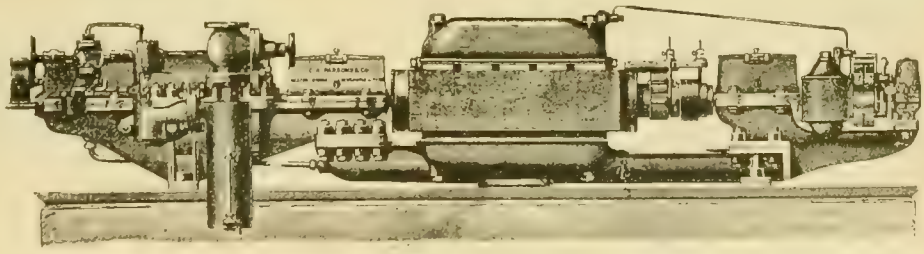
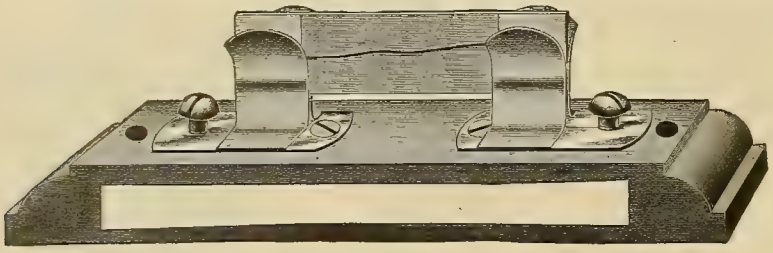


FIG. 2. DYNAMO AND STEAM TURBINE.

Fusible Strip and Holder.

The cut shows a very handy form of fusible strip with holder, especially designed to protect telegraph, telephone and other instruments from damage by lightning, or heavy currents. By a new process the fuse wire is adjusted to blow with any desired current, that in the cut being for a current of one-half ampere. When a fuse blows the strip can be removed, and a new one substituted with the greatest facility. The device is placed on the market by the Central Electric company, Chicago.



FUSIBLE STRIP AND HOLDER.

Death of T. P. Conant, New York.

The announcement of the death of Thomas Peters Conant at New York last week was received throughout the electrical fraternity with expressions of profound regret. Mr. Conant was universally respected and admired, and in his death the electrical fraternity has lost one of its most promising members. At the time of his death Mr. Conant was at the head of the engineering department of the eastern district of the Edison General Electric company. He ranked high as an electrical engineer and inventor, and took a prominent part in the American Institute of Electrical Engineers. He entered the electrical business shortly after finishing his education as a protege of Edison, with whom he was associated in laboratory work for a number of years. Afterward he became interested in other departments, and in 1888, together with William Hood, opened an office in Chicago representing the Electrical Accumulator company of New York. While in Chicago Mr. Conant took an active part in the proceedings of the Chicago Electric club, of which he was a member.

On the reorganization of the Edison company he returned to New York to accept a position in the engineering department, where he remained until the time of his death.

While Mr. Conant was best known as an electrical engineer, and although most of his time was devoted to his profession, he possessed marked literary ability. He was well read and enjoyed the society of literary men. In a word, he was an accomplished gentleman, and his death will cause profound sorrow among his numerous friends.

Wisconsin Electric Club, Milwaukee.

At the last meeting of the Wisconsin Electric club the president, A. J. Rogers, read a paper upon recent advances in electro-metallurgy, considering the subject in the restricted use of the term, and including only the application of electricity to the reduction of metals from their salts or ores. Until quite recently electric energy has been applied on a commercial scale only to the reduction of copper from its salts; and even here it has been mainly confined to the refining of crude copper. The author stated that it is probable that the electrical methods will never be able to supplant the present methods where carbon and hydrogen can be used at a comparatively low temperature to produce complete reduction of the metal from the ores. It is to metals such as those of the alkalies and alkaline earths, magnesium and aluminum, which are reducible only with great difficulty, that the electrical methods will receive the most extensive application. At the same time these metals cannot be successfully extracted on a commercial scale from their salts by electrolysis on account of the powerful reducing action of the liberated metal upon the water.

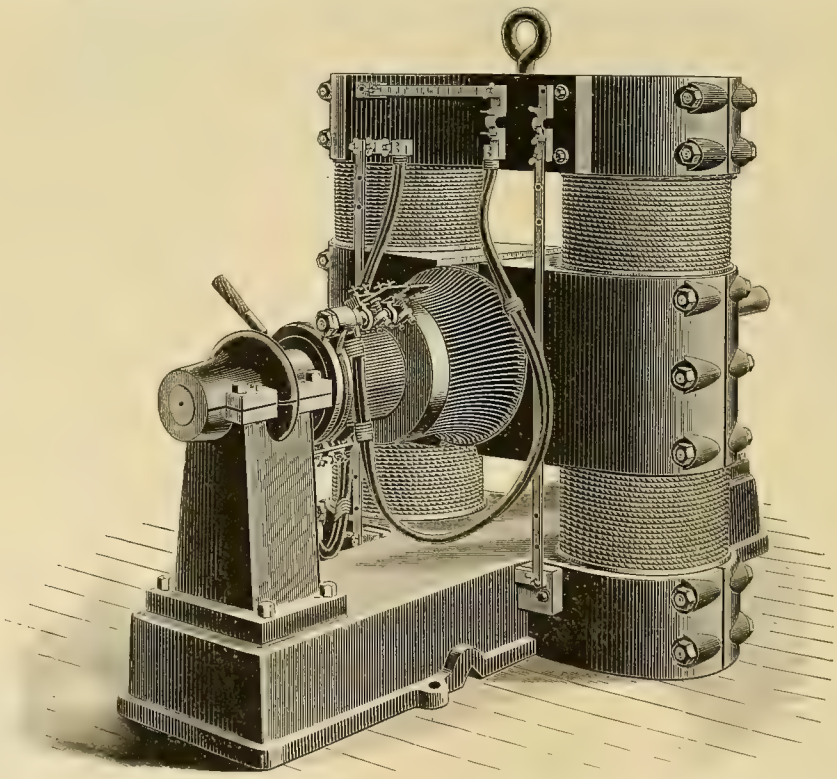
Aluminum, the most valuable of all these metals, the speaker said, is now being successfully and cheaply obtained by the electrolysis of its fused salts, or of a solution of the aluminum compound in some flux or solvent that is not readily acted upon by the liberated metal. It is in working out the details of the electrolysis of fused compounds of aluminum that success is now being attained in putting this metal upon the market at a comparatively low price, it having gone from $10 to $2 per pound within the last two years, since the electrolytic or electrochemical methods were first applied on a larger scale. A pioneer in the electrolytic manufacture of pure aluminum is the American Aluminum company of Milwaukee, which in an experimental plant in that city had up to about three years ago produced more pure aluminum than had ever been made before by direct electrolysis.

Prof. Rogers reviewed the electrolytic process of Kleiner, Heroult, Hall, Minet and others, and stated that probably Bernard Bros. in France and the Pittsburg Reduction company in this country are now producing the largest amount of pure aluminum. The Cowles company and the Heroult company are producing the largest amount of aluminum bronze, applying the electrothermic method, where the current is made to produce intense heat, and in the presence of carbon and copper (or iron) reduction of the metal takes place, and the alloy of copper (or iron) is formed.

Bain's Large Generator.

In a recent issue of the WESTERN ELECTRICIAN it was stated that Foree Bain was bringing out a line of small motors. That Mr. Bain by no means confines himself to what might be called "electrical bric-a-brac" will be appreciated by an inspection of the accompanying illustration. The cut represents a 160,000-watt generator recently constructed according to Mr. Bain's designs by the Bain Electric Manufacturing company, Chicago.

The dynamo is substantially built, weighing, it is stated, ten tons. The field cores are of wrought iron, and the coils are wound on spools which can be readily slipped over the cores. The commutator is large, and the bearings are self-oiling.



BAIN'S LARGE GENERATOR.

As to the electrical features of the machine it may be stated that its normal e. m. f. is 500 volts, and is compounded for a rise of 10 per cent. on full load. The builder states that there are only 720 feet of wire on the armature, and the resistance is .0184 ohm; the shunt field resistance is 365 ohms.

One of the special features of the large types of dynamos of Mr. Bain's design is that all the coils on the armature are of equal length, and each coil has an insulated and positive "driver" firmly attached to the cores. On these large machines there is also an air space entirely around each wire of the armature.

The Bain Electric Manufacturing company furnish generators up to 500-horse power.

Rapid Transit in Cities.

The New York Electric Club devoted its meeting of Thursday evening, Feb. 26, to the subject of "Rapid Transit in Cities." Among the prominent gentlemen present were the following: Louis J. Henitz, commissioner of works for the annexed district of New York; Louis Sterne, C. E., engineer of the Greathead tunnel system; T. Graham Gribble, prominent street railway engineer of London, Eng.; C. E. Emery, a prominent steam engineer; W. J. Richardson, secretary American Street Railway association; H. H. Neill, editorial staff *Commercial Advertiser*; C. O. Mailloux, electrical engineer of the Metropolitan street railway of Washington; Edward Weston, Newark, N. J.; Frank J. Sprague, New York.

Mr. Sprague made the following address on "The Rapid Transit Situation in New York:"

There is no rapid transit in New York, it is all situation. For years we have patiently sat lean and hungry with eyes expectant and pangs increasing at a Barmecide feast, and as the guests have multiplied, the scantiness of the table has become more and more apparent. Horse cars served in old, hackney service dressed with cobble stones, elevated railroads and cable roads with sauce of golden promises, all have been set before us and we have been bidden to eat and be merry. We have eaten and voraciously, but with little satisfaction of appetite. We have become gourmets, our tastes are more refined and luxurious, our needs imperative. The courses which have been served are stale, and have lost their flavor. We need a new chef and a new cuisine. That chef is the electrical engineer and the dish which he aims to provide is a perfect system of rapid transit, operated by electric motors, and set before us with prompt, cleanly and perfect service. Others have told you of the needs of sister cities. New York's are peculiarly her own, and that which may serve less exacting requirements will fall short of satisfying her. But it may be incidentally remarked that what we seek here ought to satisfy at least in part the needs of others.

The formation of New York city, sixteen miles long, and with an average breadth of only 2 to 2½ miles, its northern end terminating at the boundaries of rapidly growing suburban towns and villages, and flanked at its lower end on the one hand by a great and prosperous city and on the other by the terminal cities of the great Western and Southern Trunk Line, but separated from both by broad and deep rivers, bisected itself by the Harlem river, and with a population whose main travel is in one direction, make her requirements peculiarly exacting but imperatively her own. While the needs of New York and not her neighbors must determine the system which should be laid out, there is one way, and it seems to me only one in which her needs can be well provided for, and the convenience of her neighbors as well.

That New York has for a long time had urgent need of increased facilities is emphasized by the great number of projects which in the last fifteen years have been brought forward and the number which are now under actual consideration. Of many of these mention is unnecessary, and time spent on them useless. They were conceived in ignorance of the city's needs, with little conception of its growth, and less regard for its future. Not only this, many of them were designed when the architectural possi-

bilities of to-day were not dreamed of for this city, when the values of real estate were undetermined, and before the great strides were made in engineering construction, and the possibilities of a new form of motive power were known.

Why New York, with its commercial enterprise, its great resources, its engineering skill and its position as the metropolis of this country should be so slow in providing for its wants is a matter of some surprise, but it may be said that the interests at stake, the magnitude of the question, and the vital importance of a correct solution of the Rapid Transit question have well made it advisable that the demand of our citizens shall be most clearly emphasized and most strongly urged before the settlement of so important a problem, and such settlement should be made after a full and careful consideration of every recent advance in engineering and every possible forecast of what is to come.

Speaking here as a representative of electrical engineers, I feel that we have cause to congratulate ourselves that the final adoption of any further plans has been deferred until 1891, for we have been witnesses of one of the most marvelous developments recorded in the industrial world, and can point with pride to the fact that the transmission of power by electricity has within the past three years taken an undeniable first place, and offers a ready solution of hitherto impossible problems That the United States has occupied so prominent a place in this development is a source of unmixed satisfaction.

Only a few years ago you formed a hopeful band of enthusiastic pioneers, poor in pocket, struggling against cynicism and ridicule, but buoyed by belief in your work and encouraged by the bright predictions of a score of early workers who had handed down the record of their work. Five years ago there were, perhaps, a dozen electric railways in the world. The number of motors used for other industrial purposes was small. Capitalists, carbuilders, street railway officials, engineers, viewed your efforts with tolerant pity. Even we electricians only faintly realized the practical possibilities. The motor was a piece of fine and delicate machinery to be carefully housed and tenderly protected. It had hydrophobic tendencies in the presence of water and a delightful uncertainty of operation. Its construction was crude, its design unsatisfactory, its function mysterious. The vagaries of the electric current were many and surprising.

When railway work was considered, to put the delicate and erratic machine under a car, exposed to the dust and moisture was indicative of insanity, to connect it with the wheel by gearing an insult to mechanics, and to govern two or more machines out of sight with fixed brushes and a controlling device in the hands of an unskilled man was to juggle with the devil. To accentuate the waywardness of the current grounding one circuit and with 450 volts potential, was surely flying in the face of Providence. To operate under the ordinary conditions of street service was pronounced impossible and to attempt to mount over a six per cent. grade would be to lose one's reputation. The operation of a number of cars on the multiple arc system was thought a commercial impossibility, 450 volts potential threatened unknown terrors of torture and death, the bare overhead wire promised unending conflagrations, while the rail circuit with mud, snow and ice was an electrical impossibility.

How all this is changed! Motors by the tens of thousands are singing songs of victory, and follow our will with implicit and instant obedience, whether near at hand or a score of miles away. We bow before the marvelous power of electricity, but we dictate its operation.

The fear of hydrophobia has passed. The six per cent. grade has become fourteen. The difficulties of gravity have been reversed. The trouble is not how to get up but how to get down; and here again, the electric motor by reason of its remarkable reversibility, admits of possibilities denied to other forms of braking.

Boston, Cleveland, Milwaukee, Minneapolis, St. Paul and St. Louis, with all their adverse conditions of ice and snow, support the largest electric railway systems. Of all the thousands of people employed in the various duties of electric railway work, not one has ever been sacrificed by contact with the standard pressure which has been adopted for street work. Over fifty million dollars represents the investment of one class of electric motor work alone in this country.

Such has been the change wrought within the past three years. Can any observing man avoid the conclusion outlined by these facts that the electric motor must not only be the propelling power of any rapid transit system in this city, but that system in its entirety must be designed with special reference to its use?

Not alone in street car work where the electric motor now holds undeniable sway, but already in inter-city communication is it outstripping the steam locomotive.

Between Minneapolis and St. Paul, a distance of ten miles, thirteen cars are performing an eight minute service at good speed in competition with the old established steam railway half hour service, and although the fare, including transfer to the city systems is less than one-half that charged on the steam service, the operation of the cars is a most remunerative business. An electric railway line over 100 miles in length is now seriously projected in Austria. My own investigations have convinced me that at a frequent interval rapid service is perfectly feasible between New York City and Philadelphia

A most instructive table has recently been made showing a comparative statement of earnings of horse, electric and steam railways for city communication. This table comprises returns for all the street railways of Massachusetts, the entire West End Railway system of Boston, the Manhattan Elevated Railroad, and three specimen divisions of horse and electric railway service in Boston, and show the car mileage and passengers carried, the receipts, operating expenses and net earnings per car mile and per passenger carried. The figures are most suggestive, and they bear out in a remarkable way my own claims and prophecies of electric railway possibilities some years ago. To quote a few of the results, I find that on the Massachusetts railways with about 24,000,000 miles (car mileage) and nearly 150,000,000 passengers carried, the operating expenses per car mile are 25¾ cents, of which about 10½ cents is for motive power, while the percentage of operating expenses to passenger receipts is 82 per cent. This almost exactly represents the facts on the entire West End Railway system when operated by horses Coming to a more recent period, I find that with three horse divisions, making something over 3,000,000 miles and carrying nearly 20,000,000 passengers, the operating expenses per car mile are a shade under 25 cents with the percentage of expenses to receipts about the same as before, 81.7. Three electric divisions, making nearly 2,500,000 miles and carrying nearly 16,000,000 passengers, give operating expenses of 20¼ cents, and the percentage of operating expenses to receipts, 64 per cent.—a most remarkable showing. Compare these figures with those of the operation of the Manhattan Elevated Railroad, which, for the year ending September 30, 1889, made nearly 31,000 000 miles and carried nearly 180,000,000 passengers. Its operating expenses per car mile was 17⅔ cents—a little over 2½ cents below that of the electric system, and the percentage of expenses to receipts 60 4 as against 64 per cent. for the electric system.

It has been generally supposed that this steam system was much more economical, but when we consider the tremendous traffic on the elevated railroads, and the fact that while they only have one engine to every four large cars, under exceptional care, and they are the product of years of the best development and experience, while the electric cars have had one and two motors for each car, exposed to the worst possible conditions, and with only practically three years' development, the difference of operating expenses is more than made up by repairs, and, I think we can safely say that the electric motor has already impreesed its stamp of commercial supremacy in the unerring imprint of dollars and cents, and with the future electric motor designed to meet the conditions of train service, subject to the same care that the steam locomotive is, there is no question that it will undeniably be far in advance.

So much for electricity. How should it be used? What shall be the routes over which to operate? What shall be the form of road? Shall it be elevated, surface or underground? How many tracks shall it have, and what shall be the system of train service.

Let us briefly review some of the proposed systems of trransit and consider what is an essential in New York. Numerous propositions have been made for replacing the horse car service by cable lines, and it has even been proposed to gridiron the city with such a system. That the cable when properly put in is an improvement on horse car service can freely be acknowledged; somewhat faster time can be made, heavier loads can be carried, trains can be operated in one, two or three car units, and it is unquestionably more cleanly; but with these acknowledged advantages, its defects are many, and too well known to make it necessary to here enter into them. It is sufficient for our purposes to bear in mind the fact that it is a surface road, necessarily subject to surface limitations, and that by no possibility can it ever give rapid transit to New York city. No more conclusive proof of this is necessary than the statement that on the proposed Third avenue cable line the different sets of cables are to operate at 4, 6 and 8 miles, and the schedule speed would be about 6 miles an hour; but even this line, and the Broadway line as well, seem in spite of all their promises to be holding back for some reason before irrevocably committing themselves, by actual construction, to the great expense necessary.

Is it not possible that the secret influence at work is a sudden awakening to the advances of electricity, which we all know will enable even a surface system to be run in a city street at least a third safer mean speed than any other system of propulsion?

And then we have our present elevated railroad system with its proposed changes, and our suggested viaduct roads. The latter by reason of the limitations which largely govern the elevated railroads, independent of the serious one of great cost, need not be considered separately from the elevated system. Of the not unmixed benefits which this system has conferred on the city of New York, I am only to glad to make admission, but it has many and some insuperable objections when considered as a possible solution of the rapid transit question, being a double track system, with frequent stops, without loop connections, subject to street grades and curves, and limited necessarily in speed. Its proposed loop connections at the Battery and Harlem river will facilitate train dispatching. It will not increase the schedule time of running; nor is any two track railroad with the street limitations which exists in the elevated system and with the traffic which it has got to carry, capable of giving high speed service. Fast time can only be had where there is freedom from bad curves and grades, where the tracks are not too crowded, and the train intervals too short, where there is a clear right of way and with distances between stops sufficiently long to allow of getting a train up to a high speed and for some time maintaining it. Already on the elevated railroads the maximum speed between stations is from two to three times the mean running speed and the duty required of engines most excessive for their limited weight and size. Hence, four tracks are an essential, two of which should be devoted to way service and two to express service. But four tracks are certainly not feasible in the streets of New York unless they are placed one set above the other, and that should not be considered for a moment, unless indeed a four track viaduct structure should be built. In any event in such a road the express tracks would have to follow the line of way of the way tracks. Where then shall be put a road? Under ground. While I have been an advocate, and still am, to erect one solitary wire for an electric railway system to replace horse car service, and have thought perhaps that the biblical admonition, "Dust thou art, and unto dust thou shall return" might just as well be applied when necessary to all electricity as to poor humanity, despite the somewhat exaggerated claims of my telephone friends, I am no believer in the so-called "God's free air" as applied to rapid transit systems in New York, because what, with our loftly buildings, and the occupancy of our streets with the elevated structure and poles of various kinds, we have no free air; but, provided, we go deep enough, I am a strong believer in God's freer earth, which is our common heritage. So I say again, let us go underground, but this is not all. What shall be the form of the underground construction? And where shall it run? Shall it be the deep subterranean, rock-blasted tunnel because our ordinary system of blasting and tunnel construction makes us subservient to the necessity of finding a solid rock in which to work, or shall it be a form of tunnel construction which can safely pierce concealed water courses, quick sands and clay? Shall it be a tunnel depending solely for its strength and resistance to pressure from above and on either side to the rocky material through which it is bored? Or shall it be a tunnel providing within itself effective methods of resistance? Shall it contain one track, or two, or four? All these are important questions. Bearing in mind the character of our soil, the accessibility of the system, the necessity of running through and alongside foundations of structures without weakening them, there seems to me but one really available system for New York. Hence I favor, in brief, four independent iron tunnels, all meeting at a common station, once every mile and a half or so, the way tunnels meeting at common stations every third of a mile, every tunnel being absolutely independent in its route except at the stations, the way routes being run to accommodate the best surface intersections for existing lines of travel, and the express route while passing beneath the way tracks at the common stations, elsewhere running in the most direct paths. Such a four track system should run up the east side, thence by loops through the annexed district and at Harlem river, thence down the west side, completing a circuit by way of the Battery. This should intersect with a two track system passing beneath the main system with access from common stations crossing New York on the 42d street line and at the Battery, and making connections with the Long Island, Broadway and Atlantic avenue stations on the Brooklyn side, and the Trunk Line depots on the Jersey shore. This system comprises about 125 miles of single tunnel for New York and 30 miles of tunnel in the loop, and would provide a most comprehensive system of intercommunication. The schedule running on way service to 15 miles an hour, and on express service 30 miles miles; and how different such a tunnel would be from that which we have known? A rigid iron structure with all vibration deadened by the surrounding soil; an almost perfect temperature; a magnificent roadbed, perfectly jointed and free from expansion and contraction; absence from dust, smoke and cinders; perfect ventilation; a structure unobtrusive in character and absolutely safe; derailment almost an impossibility; a system of braking and signaling unequaled, and a prompt and reliable high speed service. Let us hope that we all may be prominent in accomplishing this result.

In the course of a paper on "Rapid Transit in the British Metropolis," Louis Sterne said that London had been favored by reason of its excellent omnibus system and cabs. "The pressure in London, therefore, is not so great, although they have made an advance over New York in seeking to solve the problem of rapid transit. Two tunnels were built in London, one by Mr. Brunnel in 1860, and one by Mr. Greathead in 1868-9; the former fell into disuse until the Metropolitan railway used it for the means of reaching the Surrey side of the river, and made their terminal at New Cross, some four miles from the mouth of the Brunnel tunnel. The tower subway, designed and built by Mr. Greathead and Mr. Barlow for omnibus traffic by gravitation, is used only for foot passengers to the extent of about 100,000 a month." Mr. Sterne followed the development down to the work of Mr. Greathead. This project was suggested by the possibilities of cable traction, but electricity solved this problem for Mr. Greathead, as neither safety nor speed in cable traction can compare with that of electricity, and the iron lined and cemented tunnel lends itself perfectly to electric traction.

C. O. Mailloux, speaking of rapid transit in Washington, said: "The bill passed by congress forbids the use of any overhead appliances. That restricts the systems to the underground electrical, the cable and the storage battery. Everything considered there was only one thing left to do and that was to use the storage battery system, which I hope can be developed to a sufficiently practical state to solve the problem now before us in Washington.

H. H. Neill of the *Commercial Advertiser* spoke of the relation of the New York press to the city's rapid transit problem, presenting in a most entertaining manner what he turned the "momentarily popular," the "probably successful" and the "everlastingly right" aspects of the question.

T. Graham Gribble spoke on "Rapid Transit in London and New York" with special reference to the topographical characteristics of the latter city. He described briefly the duplex railway system, the adoption of which as a means of solving the rapid transit problem he recently advocated before the commissioners.

MR. STERNE: I would like to say that I forgot during my remarks to state that the Hudson river tunnel is now being built on the Greathead system, and we are advancing there at the rate of ten feet a day. The last two or three days we have really made fifteen feet a day.

CHARLES E. EMERY: The relations of the electrical systems to steam settle themselves by the facts. We map down a cable running through a groove, but at the end of it we have a steam engine, a boiler and a place to burn the coal. We have overhead a wire which the trolley presses; but at the end of that is the dynamo, the engine and the place to burn the coal. As yet we have no good pyro-magnetic, and so long as you must burn the coal and make the steam the steam engine directly applied will for very long routes take the lead. The locomotive is not so economical as the triple engine to be sure, and you can run the dynamos with the triple compound engines and get down to 15 pounds of water per horse power per hour, and coal proportionately; while the locomotive will take

twenty-four to twenty-six. But you have first this conversion into electricity in the dynamo and the conversion of the electricity into power in the motor—you have double loss, and if you get 75 per cent. when you get through, you have done well It will run down, undoubtedly, in the neighborhood of fifty or sixty per cent. when you average up. So that the gain you get by the triple compound engine is lost by the necessity of going through so many operations before you get the power. Now, you are only even. Therefore it seems that there is a chance for electric motors even in railroads of considerable length. No, you are handicapped again by the necessity of having these electrical conductors, and the farther apart the stations the larger the conducting wires must be, and therefore it does not seem feasible. But it does seem that the steam engine directly applied, for roads of considerable length, will hold the lead for a considerable number of years.

EDWARD WESTON: I shall not attack the problem of rapid transit from what I should strictly call the point of view of engineering difficulties as separated from the electrical difficulties connected with it. I take it for granted that the engineering difficulties can readily be surmounted; that they are not very serious in character outside of the question of cost.

We are located in a city where property values are very high. We must acquire the right of way for the passage of our trains for the accommodation of the public at large. Having acquired the right of way the problem falls either upon the mechanical engineer who would take up entirely the old mechanical means of transmission, or divide the responsibilities, the mechanical engineer taking care of what may be said to be the mechanical part of the business and the electrical engineer the electrical part. I shall dismiss the mechanical engineering branch, conceding that that can readily be overcome, and consider only the electrical engineering difficulties in the way. Mr. Emery has said that for the general purpose of carrying passengers long distances steam takes the lead. It does to-day, unquestionably. Does it necessarily follow that it should take the lead because at the present moment we have to depend upon steam for the generation of the energy that we require to propel our electric vehicles? I do not think so. I think therein lies a very grave mistake, The steam engine is an exceedingly inefficient means of transforming the energy derivable from the coal into available power or for doing useful work. When it is considered that the best of our steam engines to-day do not yield us over about 20 per cent. of the actual energy of the coal, you can appreciate the unfortunate position of electrical engineers. The dynamo can be made to-day to yield 98 or 99 per cent. of the energy expended upon driving it in actual electrical energy. Of that, 94 or 95 per cent. can, under proper design, be again utilized in the form of electrical energy. That is, it can be delivered out. Now taking into consideration the extreme difference between the steam engine and the dynamo, and notwithstanding the remarks and publications of many very eminent authorities in regard to the dynamo that the motor is not of the same efficiency as the dynamo, I venture to say that that is entirely a mistake. Whatever the generator will do in the shape of efficiency, that the motor will do. If we do not do it it is because we do not carefully study the problem or we are unwilling to spend more money to secure the results. But the question as to the efficiency of these two systems, that is the efficiency of the motor and the efficiency of the generator as compared with the efficiency of the steam engine, is not entirely one of the prime motor. It is another thing. In the locomotive we have to deal with a very different problem from that which presents itself in the electric motor. In the latter the efficiency does not decrease very perceptibly with a reasonable decrease in size of the motor. In the steam engine, on the other hand, it does decrease with a reasonable decrease in size. A small electric motor can be made of nearly the same efficiency as larger ones. Now such being the case, small motors applied to the axles, or with their power diverted to the axles of the cars in such a manner as to eliminate all loss between the motor and the cars, will yield vastly greater results and better results than a single steam engine located at the head of the train. I think Mr. Sprague some years ago considered that question and pointed out the vast superiority of the electric system in efficiency as compared with the steam system, when it was taken into consideration that each car had its unit motor and that the tractive force of the whole train was distributed proportionally to the actual load on the respective parts of the train. The tractive force in the case of a steam locomotive must all be put in the locomotive. We all know how many tons have to be put on a locomotive in order to get that tractive force and how far that may be reduced, and how far the efficiency of the electric system may be made to exceed in general that of the steam system will be better understood when that question is more thoroughly experimented on and studied than it has been thus far. It does not follow by any means that we must have a less efficiency by the intervention of an electric motor. On the contrary it may be proved, and I think will be proved, that the electrical system will be more efficient than the steam system as generally employed.

In considering the question of what is the best means of rapid transit for a city like New York, we have a number of problems to deal with outside of the question of first efficiency or economy. There must be convenience, quickness of stopping and starting, and every one will concede that the lighter the parts that are to be moved the quicker we can stop and start, the less wear and tear, the less strain on our apparatus and generator. Consequently, the electrical system should possess an enormous advantage over any steam system by reason of the fact that from the lighter loads and the lighter weights you have to carry in proportion to the power developed, you could stop and start quicker without injury to the machinery. Then again in the electric motor we have something entirely different from what we have in the steam engine. We have no reciprocating parts, but continuous rotary motion. The strains are all tangential, and that ought to aid greatly in running and maintenance. The electric motor of to-day is not what the electric motor of a few years hence will be. To-day we are struggling with difficulties connected with the commutator end of the line, which has been the great bugbear of all systems of electric railroads. Commutators and brushes require more care, outside of gearing, than anything else we have to deal with. They are the weakest spot in the motor and they are the weakest spot in the dynamo. The question arises, can those difficulties be overcome? I think they can. But if they are not overcome, are they not already sufficiently overcome to warrant our placing our reliance upon such a system of transmission? Well, the railroads we have already built, I think, are a sufficient answer to that question. Much of the railroad work that has been done here has been experimental in character and must continue so for some time. In connection with the motor we are laboring under very serious difficulties in regard to regulation. In the electric motor we cannot do just exactly as we do in the steam—adjust our point of cut-off so as to secure the best results with a given load. With the steam engine you can do that to a certain extent with a given size of engine. With the electric motor, unfortunately, we cannot do that at present. We have to govern our motors by varying the resistance in the circuit which means loss, necessarily, because that resistance has to be overcome to some extent by the current passing through it or by reducing the intensity of the field magnet, which also means loss Now that is unfortunate, but is it necessary? I think not. The ideal electric motor for the transmission of power would be a motor running at a continuous rate of speed and with a variable gearing, giving the motor the advantage of power when the car was first started. That we have not exactly reached. The need for such a system as we have to deal with here in the city of New York, where enormous amounts of power would be required, are not by any means easily solved. I do not think any direct current system would entirely answer the purpose without a large number of stations and comparatively small units of power. During the last few years considerable development has taken place in the art of electric lighting in certain lines, which I may briefly refer to as the alternating current system. It is now well understood that that system does not lend itself very well to the transmission of power—that there are grave difficulties to be overcome in connection with the motors. The co-efficient of self-induction, or the kick back, so to speak, of the motors themselves alone interposes a great obstacle to the output per unit of weight But there is no reason in the world why continuous current converters should not be made vastly to exceed in efficiency the alternating current motors under all conditions of load, which would enable us to distribute currents of enormously high potential over very long lines by means of comparatively small conductors. It seems to me that herein lies the future success of such a system as has been discussed here to-night—that if we expect to reach high speeds and get economical service we cannot hope for a distribution based upon the direct application of the current, but upon some modification of it through a secondary converter by the direct current converter.

CORRESPONDENCE.

New York Notes.

NEW YORK, Feb. 28.—The investigation into the tunnel disaster which last week sent a thrill of horror to every person who passed through the black tunnel leading from the Grand Central station to the Harlem river was continued yesterday, by Coroner Levy and his jury. The facts which are being brought out are such as to make it very surprising that many such accidents have not already occurred. There is no doubt that the signals were properly set but the engineer, either through carelessness or inability to see the lights in the smoky, dark tunnel, ran his engine and train past, into the next block, where the accident occurred. One of the signal operators in his testimony admitted that the signal service would be much more efficient if there were two men at all times in each signal cab, one to look exclusively after the levers and the other to do the telegraphing and keep the record of the trains passing The investigation will be continued next Tuesday. The public now demands that the New York Central Railway company fulfil its promise of months ago to light and ventilate the tunnel. An elaborate system was worked out by engineers for a great electric plant to light the tunnel and the management had the matter under so thorough consideration that the public was expecting its speedy accomplishment. The time has now come when such a system must be adopted and the repetition of the terrible disaster avoided.

The meeting of the Rapid Transit Commissioners last Thursday was a session devoted almost entirely to the scheme of the People's Rapid Transit company, which means the construction of a viaduct through blocks and in no way will interfere with the present facilities of transit through the streets. Mr. Chittenden, president of the company, gave in detail an exposition of the scheme, but the proposition which he supported with arguments that "an adequate rapid transit railroad in the streets, avenues and boulevards would be more expensive than a railroad of equal capacity over a purchased right of way" was a surprise to the commissioners. Mr. Chittenden estimated the cost of a viaduct railway for four tracks from the Battery to King's Bridge would be $109,700,000.

The Board of Electrical Control in some way has managed to get together its crippled forces again and at the meeting held yesterday the three resolutions proposed by Mayor Grant came up. The resolution requiring all electric light and power companies maintaining house-top wires in districts where there are subways to have them in the subways within thirty days was passed. All these wires have been put up without permission. The resolution requiring the Consolidated Electric Subway company to build subways in all the streets that are to be repaved where subways are required was next adopted. The representatives of the electrical companies were notified to inform the subway company within one week as to the streets in which they want the subways built. When the mayor promised the electrical men that the subways would be built, he added: "Don't come here after the new pavements are laid and say that you cannot take down your poles because there are no subways. There won't be any tearing up of streets to build subways either."

The resolution compelling all companies having poles and overhead wires in the district bounded by Third and Eighth avenues, Eighth and Fifty-ninth streets, to take them down before June 1st was passed after a discussion. In asking that certain streets be excepted from this order Paul D. Cravath, counsel for the United States Illuminating company, said that there were no subways in Seventh avenue from Fourteenth to Forty-second street; Fifth avenue, below Twenty-third street; the east side of Third avenue, from Eighth to Fourteenth street, and Clinton place, University place, and Ninth street. Ex Judge Kelly of the East River Electric Light company made the same request.

President Cutler of the Metropolitan Telegraph & Telephone company asked if the resolutions would affect the distributing poles of his company. The mayor said that the resolution was intended to rid the streets of all poles and overhead wires. He advised the use of housetops for distributing purposes. Mr. Cutler said that sometimes the people would not let them use the housetops.

"Then let them do without the telephones," said the mayor. "Those people who won't have wires on their roofs can't have poles in the streets for their especial accommodation." The resolution was passed without any exceptions being made.

The fight for the trolley system in the annexed district has come before the railroad commissioners, and the counsel for the property owners claims that enough have withdrawn their consent to throw the majority against the railroad company seeking to introduce the system. The commissioners decided to hold the case open for one week to give each side an opportunity to examine each other's papers.

The meeting of the American Institute of Electrical Engineers was attended by over two hundred members on Tuesday evening, the 24th inst. O. T. Crosby's paper on the high speed attainable in electric railways excited the deepest interest.

The "rapid transit dinner" Thursday evening brought together one of the finest gatherings ever seen at the Electric club. The selection of speakers who presented their views on the subject of rapid transit was admirable.

James H. Manson of Brooklyn gave an interesting address before the Epworth League recently and illustrated his remarks with experiments which greatly pleased his audience.

W. H. T.

San Francisco, Cal.

SAN FRANCISCO, Cal., Feb. 25.—The last three weeks have witnessed quite a struggle between the friends and opponents of electric street railways, the scene of battle being the halls of the California state legislature at Sacramento. Hitherto, electric railway corporations have had no legal existence, to which perhaps is largely due, the fact that there are but three such roads in operation in this state. Now, however, if the measure that has passed is supported, electric roads will be on the same level, legally speaking, as horse, cable or steam roads. As originally introduced the bill permitted the use of electric railways only in cities and towns having a population less than 250,000. This excluded San Francisco, and the belief is prevalent that the bill was thus framed in the interest of cable roads. The Omnibus Cable Railway company of San Francisco, is exceedingly anxious that its Howard street cable line shall not be paralleled by electric roads on Mission and Folsom streets where car lines are now maintained from the ferries to Thirty-second street. An effort was also made to defeat the proposed overhead road between Berkeley and Oakland. The controversy growing out of the introduction of these bills led to bitter personalities and grave charges of "boodling" were freely exchanged.

The San Francisco *Chronicle* fell in line with the cable interests and reprinted in full the tirade against overhead wires that appeared originally in the New York *Times*. The friends of the advancement were triumphant, however,

for the amended bill as finally passed in the assembly makes electric railways legal corporations in San Francisco as well as in other cities. The electric bill, as it was called attracted a great deal of interest, owing to the desire of the public for more electric roads, and to the charge made that the measure was being fought by boodle.

The senate also adopted the electric street railway bills. An ineffectual effort was made to exclude San Francisco from the benefits of the measure. The bills now go to the governor and if approved, as it is believed they will be, the fight of the San Francisco cable interests against electric street railways will doubtless be taken into the Board of Supervisors of this city.

Until within the past year San Francisco has been further behind in the procession of electrical progress than many Oregon or Washington towns having less than one hundredth of her population. With the exception of not more than a dozen isolated incandescent plants and probably 500 other incandescent lights supplied to two consumers by a central station, the metropolis of the Pacific Coast had only arc lights, until last year. As to motors, everything is constant current, and it is quite probable there is not a single constant potential motor in commercial use in San Francisco. In fact, with the exception of two small machines no central station circuit exists in San Francisco from which constant potential motors may be run.

There are two electric lighting concerns in this city. The older of these, the California Electric light company, was established ten or twelve years ago, and until about 1889, it held the field without a rival. Two years ago, however, the Electrical Improvement company applied to the Board of Supervisors for a franchise, but did not get it. About that time, though, the State Board of Harbor Commissioners which has control of the water front of San Francisco, advertised for bids for lighting sections of the sea-wall. The old company permitted the new one to under-bid it, so the story goes, and the contract was awarded to the Improvement company. The holding of an electric lighting contract with Harbor Commissioners, carries with it the privilege of erecting poles along the water front of the city, so the Improvement company secured the foothold that the supervisors refused to grant. A small corrugated iron station was erected down on the water front, a couple of Wood arc machines with necessary steam power placed in it, and the new company entered upon the fulfillment of its contract with the Harbor Commissioners. Soon the Wood arc lamp began to make its appearance in business places along East street and housetop wires began to reach out up town in violation of a city ordinance prohibiting such construction. Then a suit was brought by the Chief of the Fire Department on behalf of the city against the Improvement company for violation of the ordinance but the company was victorious, and in the early part of last year the Improvement company's lamps had worked their way up as far as Kearney street. Business then grew rapidly and now the little water front station is worked to its full capacity, or that of four Wood arc dynamos and one Slattery 1,000 light alternator. At last year's election, the political complexion of the Board of Supervisors was changed and now the Improvement company hopes that the new board will grant it a franchise, in which event, more money will be put into the concern and its station be rebuilt and equipped in a first class manner.

Meanwhile, the California Electric Light company has been enlarging its plant and improving its service and making friends and business on all sides, until now its two stations and plant are such that the managers of the concern, have every reason to feel proud of their work.

A 1000 light Slattery alternating incandescent plant is being placed in Los Gatos, Santa Clara county, Cal ,for the Los Gatos Electric Light company. The Electric Improvement company of San Francisco, Western agent for the Fort Wayne Electric Electric Light company has the contract.

The Pacific Coast District office of the Edison General Electric company finished the installation of a ten car electric road at Sacramento last week. The road is now running smoothly.

Work has been commenced on the big contract held by the Thomson-Houston company, for placing the lighting and power plants at Mare Island Navy Yard for the government.

The installation of an 800 light central station in Willows, Colusa county, Cal., has just been completed by the Edison General Electric company.

A bill has been introduced in the state legislature making telegraph companies common carriers, and fixing their liabilities as such. The measure passed the assembly on Thursday by a constitutional majority of one ballot, but notice of a reconsideration of the vote was given. The matter will come up again early next week. S. I.

Indianapolis, Ind.

INDIANAPOLIS, Ind., Feb. 26.—A bill has been introduced in the Indiana state senate making telegraph companies liable to a penalty of $100 if a message is not sent in the order filed, also a penalty of $100 in case a message fails to reach its destination, or is delayed so it fails to serve the purpose intended. The proposed measure is the same as the law repealed by the legislature of 1885.

The postoffice building is now lighted throughout by electricity, incandescent lights inside and arc lights outside on Pennsylvania street and Market street. The current is furnished from a clothing store plant just across the street. The Fort Wayne Jenney company's machines are used.

Quite a fight is on in the legislature over the bill to allow suburban lines to use the tracks of an existing company to reach the business portion of a city. The people of Irvington, Broad Ripple and Greenwood are interested in rapid transit to this city, while the Citizens' Street Railway company is doing all in its power to defeat the bill. The indications are if the bill is passed, it will be so amended that it will be practically useless.

The new storage battery cars are in use on the line between this city and Irvington, and appear to be giving satisfaction. M.

Milwaukee, Wis.

MILWAUKEE, Feb. 28.—An engineer has been looking over the right of way of the Pfister Railway company with a view of preparing specifications and making estimates of the cost of building the lines. It is understood that the work will go ahead without unnecessary delay.

One of the bills submitted to the Wisconsin legislature provides that the Wisconsin Telephone company shall not put telephones in disreputable houses. The telephone people assert that such a law would be unfair because it would presuppose a knowledge on their part of what are disreputable places.

The Villard syndicate has received permission from the government to build its National avenue line into the Soldiers' Home grounds. The syndicate is also credited with the intention of building a line to Schwartzburg, two miles and a half northwest of the city.

A bill to increase the percentage of state tax that the Wisconsin Telephone company pays has been introduced in the legislature.

It is settled that A. W. Lynn, who was to have been transferred to Chicago, will remain as manager of the Cream City Railway, and it is likely that the Milwaukee City Railway will also be placed under his charge. C.

THE ELECTRIC LIGHT.

Jackson, Tenn,, has issued bonds for an electric lighting plant.

Martinsville, Va., citizens are talking of lighting the town by electricity.

It is reported that the city of Clarksdale, Miss., will put in an electric light plant.

The city of Troy, Ala., has entered into a contract for the erection of an electric light plant.

At Salisbury, N. C., the Gas and Electric company will probably erect a new electric light plant.

Electric lighting will form a portion of the business of the new Mining and Improvement company of Bentonville, Va.

At the annual meeting of the Louisiana Electric Light company the following directors were elected: Brainard Rorison, Jos. Simon, R. T. McDonald, Jno Nelson, M J. Hart, A. A. Woods and S. I. Hart. The officers for the coming year are: president Brainard Rorison, vice-president, Jos Simon, secretary and treasurer, F. S. Neustadt.

The Vincennes, Ind., Electric Light and Power company held its sixth annual meeting on Feb. 26. The election of directors resulted in the choice of Hiram A. Foulks, Gerard Reiter, Charles Bierhous, John B. La Plante and Royal E. Purcell. The last two gentlemen are new directors, replacing J. T. McJinsey and J. D. La Croix, retired. Charles Bierhous was elected president, H. W. Frund secretary and general manager, and H. A. Foulks, treasurer.

THE ELECTRIC MOTOR.

A contract has been awarded to the Thomson-Houston Electric company to build and equip five miles of an electric street car line in Clinton, Ia., for the State Electric company, to be completed by June 1st.

Judge Kinne of Ann Arbor, Mich., has handed down a decision in the case of Elizabeth Kaffensperger and others against the Ann Arbor street railway company in which the court holds that, so far as the rights of abutting property owners are concerned, there is no legal distinction between animal and mechanical power for street railways. He says that "in the present state of electric art poles and wires are essential elements in the system of electric railways," and that "private convenience and interests must sometimes yield to public good." The case of telegraph and telephone poles is different, as their employment is "foreign to the natural and legitimate use of public highways. They do not assist or facilitate passenger traffic, and may be deemed increased burdens and servitudes."

The Westinghouse company has been awarded a contract to change the present motive power of the Riverside & Highland Park railway at Sioux City, Ia., from steam to electricity. The contract also includes two miles of new line. The cars are to be supplied with two 20-horse-power motors each.

The Winston Electric Light and Motive Power company and the Winston-Salem Street Railway company of Winston, N. C., have consolidated under the name of the Winston-Salem Railway and Electric company with J. H. McClement, president; E. L. Hawks, vice-president, and W. H. Mason, secretary.

An underground electric railway from London to Hammersmith is projected. It is proposed to construct two iron-lined tunnels—one for the up traffic and another for the down traffic. One track will be laid in each of the tunnels. The distance to be traversed is about six miles, and there are to be 14 stations, including terminals. First and second class carriages are proposed.

The Day Railway Construction company has been incorporated at Chicago; capital stock, $10,000,000; to construct and contract for the construction of surface and elevated railways, and to construct and contract for the construction of subterranean railways, including rolling stock, motive power, and other appliances constituting a complete railway equipment; incorporators, St. John V. Day, Edwin F. Getchell and Willard T. Block.

New plants or extensions of electric railways are contemplated in the following named places: Mobile, Ala; Clinton, Mass.; Augusta, Me.; the Lynn, Mass., Belt Line Street railway; the Multnomah Street railway, Portland, Ore.; Covington, Ky.; between Graham and Buckington, N. C.; the University Park railway and Electric company, Denver, Colo.; the City railway, Elgin, Ill. the Globe Street railway, Fall River, Mass.; Vernon, Tex.; the Valley Street Electric railway, Seattle, Wash.; Buffalo, N. Y.

The formation is announced of the Standard Electric company at Chicago; capital stock, $100,000; for the manufacture of electric light, motor and other machinery, cars, vehicles, cells, batteries, accumulators and other appliances, to establish and operate electric light and power plants and stations, to equip and operate cars, conveyors, and other lines of communication and to do any business to which the application of electricity, steam or gas may be adapted; incorporators, William A. Conover, Francis E. Charnley, and Frederick M. Clocke.

During the present year, it is said, the first elevated electric railway in England will be opened at Liverpool. It will be a dock line, seven miles in length, and the total cost of construction is estimated to be £348,700. This railway will consist of a double line, for passenger traffic only, and will extend from Fort Road, Seaforth, to the Harrington Dock. The tracks are carried on a wrought iron viaduct. Stations will be erected every half mile in the thickly populated districts. A traffic of 5,000,000 passengers is expected for the first year. The exact system of electric propulsion to be used has not yet been determined.

At the last meeting of the Harvard University Electric club, Feb. 20th, the members enjoyed a very interesting lecture by Lieut. Cahoon of the Thomson-Houston company. He described the slow speed railway motor which the company has just introduced. A number of interesting facts were given, showing the skill and care with which the various parts have been designed. A car equipped with the new motor was loaded with three tons of gravel and started up a grade of at least 13 per cent. on a radius of about 50 ft. The amperes ran as high as 146, but the motor tugged up the car successfully. Comparisons between the new and old types show, it is stated, that the former requires 10 per cent. less current to do a given work. The large size of the armature prevents the jerk given when the car is started.

The Dubuque Street Railway company is so well pleased with the running of the experimental storage battery car operated on the Edco system, and which has been running in regular daily service since last August, that it has concluded to order from the Accumulator company three additional cars of the same kind; delivery is to be made in April. This will make nine Edco cars which the Dubuque company will have in operation, the first six of which are about ready for delivery and will be installed in March The Accumulator company will rent to the Eckington & Soldiers' Home Railway company two Edco cars, which are about ready for delivery, and which are to be operated upon the G street branch of that road between the Treasury Department and the Pension Office, and thence to corner of New York avenue and Fifth street. The six new Edco cars recently contracted for will not be ready for delivery till May or June.

Miscellaneous Notes.

The Baltimore Electric Refining company has been incorporated, with a capital of $500,000, for the purpose of doing a general metallic manufacturing business and for washing and smelting ores by electricity. It is said that the plant will cost $200 000, The company has secured a site at Canton, Md., for its works.

A letter from London says: I. I. Murphy, son of Co. [illegible] Murphy of Brooklyn, is over here making arrangements for a trip around the world. He will leave New York about the middle of April in a [illegible] American life-saving yacht, and will visit all the principal ports of the British Isles, France, Spain, the Italian peninsula,

and the coast towns of the Mediterranean, thence across the Black Sea to Odessa and through the Suez Canal and Indian Ocean to China and Japan and across the Pacific to San Francisco. Murphy will take with him one of Edison's phonographs and several hundred cylinders, and he intends to transfer to wax the voices of various peoples he will visit, particularly those of savages. He will also stop at Pitcairn Island to bring back with him in a phonograph the story of the mutineers of the Bounty as related by their descendants. He intends to complete his journey in time for the World's Fair in Chicago, where his boat and phonographic records will be exhibited. Only two sailors will accompany him on the cruise.

Personal Mention.

A. B. Gould, general manager and treasurer of the Sioux City, Ia., A. D. T. company, was in Chicago last week.

L. W. Collins has been appointed manager of the Western department of the *Electrical Review*. Mr. Collins has a wide acquaintance in the electrical fraternity. He was formerly manager of the Chicago Electric club.

Business Mention.

The Pittsburgh Sheet Metal Tool company will hereafter be known as the H. H. Hipwell Manufacturing company.

The Card Electric Motor & Dynamo company of Cincinnati, has shipped a six-horse power arc motor to St. Louis.

Frederic L. Merrill will represent the Consolidated Electric Storage company in Chicago. His office is 565 Rookery.

The branch office of the India Rubber Gutta Percha Insulating company is now located at 315 Madison avenue, corner Forty-second street, New York city.

Thomas L. Townsend, representing the Partrick & Carter company of Philadelphia, will make an extended trip in the interest of his company, He will place several new specialties on the market.

W. R Mason of the Electric Merchandise company announces an unusually bright outlook for the season in street railway construction. He says every department is crowded with business and that several large orders have already been placed with his company.

The Hazelton Tripod Boiler company, Chicago, has issued a new and attractive catalogue, containing descriptions of the Hazelton tripod boiler, the Hazelton purifier and the Hazelton vacuum heater, with records of tests and flattering letters of recommendation.

In order to better supply its Western trade the A. W. Harris Oil company of Providence, R. I., has opened an office at 55 South Canal street, Chicago. This company is making a special effort to supply electric light stations with valve and dynamo oils. E. P. Allis is the Milwaukee representative of the company.

The Great Western Electric Supply company, Chicago, Ill., has been rushed with orders since it reduced its prices on lamps, and it has been necessary to run the factory night and day for the last week. It has not been able to fill orders fast enough, but it is now prepared to handle orders promptly, as new machinery has been added, and the facilities have been about doubled.

The Electrical Supply company, Chicago, has just brought out a new device called a "toggle bolt," which overcomes the difficulties heretofore experienced in attaching to brick or stone walls, tiles, etc. A hole is drilled in the wall, the bolt inserted, and the action of a free cross-arm prevents its withdrawal. These "toggle bolts" will be of great service in many places where it has been difficult to wire securely.

The Electric Merchandise company, Chicago, hereafter will handle the girder rails, tram rails, T rails, chairs, tie plates, splice bars and street railway equipment of the Tramway Rail company of Pittsburgh, Pa.. The company has just issued a preliminary catalogue of these specialties. It announces that it is not the intention to experiment, nor to revolutionize present methods, but to follow well established principles, making all equipment strong and durable.

Parker & Hyde of Milwaukee have issued a new edition of "Telephone Troubles and How to Find Them," containing diagrams of bells, hand telephones and microphones, connected up for use. In addition, the book contains valuable information as to the cost of building private lines, etc. A wire table, giving weights and resistance of wire per mile, is an additional feature. The book is substantially bound with flexible covers for pocket use. The book is highly recommended by practical telephone managers.

A new corporation, known as the Trans-Missouri Electrical Construction & Heating company has been organized at Lincoln, Neb., having for its object the construction of railway and lighting plants and the supplying of heat and power. This field would seem to be a most promising one, and the favorable auspices under which this company makes its start ought to insure success. The following officers have been elected: President, G. W. Enslow; secretary and treasurer, G. W. Hartman; general manager and electrician, F. J. Pearson.

The Page Belting company of Concord, N. H., manufacture in their extensive works all the staple grades of leather belting, making specialties of wide main belts, particularly for electric plants, and also of a special grade of single belting, which they call the crown extra. During the past year they have added to their specialties for electric work, their Acme Link Belt, of which they have sold a large number, with the very best results. They also report large and increasing sales in their dynamo double flat belt for driving dynamos.

This establishment now has stores in New York, Boston, Chicago and San Francisco, having recently opened at No. 16 Dey street, N. Y., where they have a complete stock of staple and special grades of belting, including lace leather, both raw hide and tanned. Among the establishments recently fitted up by them with belting are the following: Ducey & Backus Lumber company, Brandon, N. Y.; Star Thread company, Athens, Ga.; Eagle Lock company, Terryville, Conn.; Lebanon Building & Power company, Lebanon, N. H.; Geo. G. Page Box company, Cambridgeport, Mass.; Sanford Mills, Sanford, Me.; Amesbury Electric Light & Power company, Amesbury, Mass.; W. F. Swords Lumber company, Bridgeport, Conn.; S. O. Cummins, Bellaire, Ohio. They have also shipped Acme Link Belts to the Warren, Pa., Electric Light company, the Wheeling, W. Va., Steel Works, and many others.

The Engineering Equipment company, organized early in February, has located temporarily at 73 Cortlandt street, New York. After April 1st, they will be in the new Central building, Liberty, West and Washington streets. The following gentlemen and others, are actively interested in this new enterprise: F. A. Magee, M. E. engineer; F. L. Perine, general manager; A. L. Tinker, secretary and treasurer. The company are contractors for steam and electric equipment materials. They represent the Underwood Manufacturing company of Tolland, Conn., makers of cotton-leather belts, and other specialties in the belting line, and are sole agents for the patent indurated fibre pipe used in electrical subway work and for other purposes. The Engineering Equipment company also represent Corliss and high speed engines, horizontal and vertical boilers, wooden and iron poles, line materials, wire and cables, underground conduits, cars and trucks, iron roofs and cranes. It is the purpose of this company to furnish equipment materials of the best class at figures which will be attractive to intending purchasers, especially to those who desire to place large orders in safe, reliable hands and under conditions that will insure the exercise of sound judgment by experienced engineers.

Electrical Patents.

Issued February 24, 1891.

446,846. Thermostat. Adolph M. Barron, Kansas City, Mo.

446,864. Electric Motor. Ludwig Gutmann, Pittsburg, Pa.

The invention consists in using alternating or intermittent electric currents in the field magnet coils of the motor, whose several cores are suitably subdivided to prevent heating, energizing the same, creating a magnetic field which by induction acts on one or more close circuited ring windings of the open or closed type, and generating in a single winding of the armature secondary currents differing in quantity and lag from one another by the external application of one or more short circuiting brushes.

446,871. Binding-Post. Charles A. Lieb, New York, N. Y.

446,873. Machine for Molding Separator-Plugs for Battery Elements. Albert F. Madden, Newark, N. J.

446,895. Fuse Block. Albert P. Seymour, Syracuse, N. Y.

446,902. Automatic Cut Out. Jacob P. Tirrell, Boston, Mass.

446,907. Indicator for Elevators. Edward Whitlock, Richmond, Va.

446,917. Electric Railway Signal. Earl T. Harvey, Chicago, Ill.

The object of this invention is to provide an electric signaling arrangement for railway trains, whereby the engineer receives an O. K. signal at different or predetermined points along the line of the road, the road being divided up into sections, each section having an independent circuit.

Claim one is:

"In an electric signal for railways wherein the road is divided into independent electric-signal stations, the combination, with the track-rails at one end of a section, of the battery-wires connected to the broken and insulated ends of said rails, the circuit-wires connected to the rails at the opposite end of the section, and returning to the battery end, and the contact signal-plates located at each end of a section and electrically connected to each other."

446,931. Trolley for Electric Railways. Sidney H. Short, Cleveland, O.

We give the second claim:

"A pole-trolley comprising, in combination with a spring-pressed pole, a contact-roller with a cylindrical periphery, and ears or guards projecting beyond said periphery."

446,966. Cut-Out. Stephen D. Field, Stockbridge, Mass.

446,967. Electric Time-Lock. Malon I. Flowers, Springfield, Mo.

The last claim is:

In an electric time lock the combination, with a bolt, dog and time-wheel arranged to operate substantially as shown, of an electric motor for imparting a continuous motion in one direction to the time-wheel, and means without the lock case for completing the circuit and putting the motor in motion.

446,974. Method of and Apparatus for Electric Welding. Hermann Lemp and Louis M. Schmidt, Lynn, Mass.

The invention relates to a process of forming longitudinal metal joints, in which the heating necessary to obtain the joint is produced by means of a current of electricity, and the welding or joining action is obtained by force expended in a direction practically at right angles to the length of the pipes or pieces to be joined.

446,985. Trolley Wire Hanger. Charles H. Macloskie and William E. Baker, Boston, Mass.

446,995. Socket for Incandescent Electric Lamps. John M. Orford, Bridgeport, Conn.

447,016. Galvanic Battery. Martin W. Robinson, Medford, Mass.

447,023. Electric Heating Apparatus. Charles E. Carpenter, Minneapolis, Minn.

447,045. Magneto Electric Signal Device. Noel B. Ginochio, New York, N. Y.

447,058. Police Signaling Apparatus. Bernice J. Noyes, Boston, Mass.

447,059. Police Signaling Apparatus. Bernice J. Noyes, Boston, Mass.

Claim ten follows:

"In a signal-box, a single circuit-changer comprising two contact members and a permanent or invariable controller consisting of contact devices to indicate the box number, combined with the number of detachable controllers, each carrying characteristic contact devices."

447,060. Municipal Signal Apparatus. Bernice J. Noyes, Boston, Mass.

Claim five reads:

"In a signal-box, a multiple-signal transmitter having as a co-operative part of it a pointer normally concealed by a door, a hand-operative actuating pull for the transmitter accessible when the door is open, and an outside key which operates said actuating pull, combined with a magneto-electric generator operated by the said actuating pull."

447,061. Municipal Signal Apparatus. Bernice J. Noyes, Boston, Mass.

447,062. Signal-Box. Bernice J. Noyes, Boston, Mass.

The invention consists in the combination, with a signal transmitter, and a key for operating it adapted to be inserted and withdrawn from the box containing the transmitter, of a piece of material arranged to be marked upon, embossed or impressed by the key.

447,074. Non-Interference Fire-Alarm Signal-Box. William H. Kirnan, Brooklyn, N. Y.

The invention consists in providing a non interfering signal box operated by a handle, and provided with a device for preventing the operation of such handle during the transmission of a signal, such device being controlled by the magnet in the box with a resetting device operated by the signaling motor for automatically resetting such disabling device into operative position at the close of the signal, so that another signal can be immediately transmitted without the necessity of performing any additional operation.

447,104. Electric Welding Apparatus. Mark W. Dewey, Syracuse, N. Y.

Of the eleven claims the sixth is given:

"The combination, with an electric lap joint welding apparatus of stops for limiting the length of the lap."

447,105. Independent Electric Clock. Walter J. Dudley Everett, Mass.

447,127. Vacuum Core for Electrical Heating Devices. Henry R. Butterfield, Waterville, Me.

447,143. Electric Heater. John I. Ashbaugh, Chattanooga, Tenn.

The invention consists in the combination of the solid center of clay or other similar material, the coil of wire wrapped closely around said center, through which coil passes the electric current, an external metallic casing adapted to radiate heat and surrounding the said coil, and an intervening heat conducting envelope between the coil and the external case, which envelope is a non-conductor of electricity.

447,166. Telegraph Transmitter. Samuel W. Smith, New York, N. Y.

447,177. Regulator for Electric Circuits. Thomas M. Edwards, New London, Conn.

447,194. Telephone. Ernest J. P. Mercadier, Paris, France

The third claim is:

"In a telephone, a diaphragm supported at points located approximately in the nodal line or lines of the first harmonic of the said diaphragm.

447,195 Annunciator and Indicator System. John E. A. Miller, San Francisco, Cal.

447,198. Telegraph Apparatus. Josiah A. Parker, St. Louis, Mo.

447,208. Cross-Over for Trolley Lines. Sidney H. Short, Cleveland, O.

The last claim is given:

A cross-over comprising a metal arch and alaminated wooden track piece secured to said arch with the bearing surface at the edge."

447,215. Electric Railway System. Charles J. Van Depoele, Lynn, Mass.

447,220. Transmitter-Circuit. Anthony C. White, Boston, Mass.

447,230. Current Controlling Device for Electric Railway Cars. Jacob C. Chamberlain, New York, N. Y.

447,255. Electric-Motor Mechanism. Samuel E. Mower, New Haven, Conn.

447,256. Apparatus for Flashing and Exhausting Incandescent Electric Lamps. William E. Nickerson, Cambridge, and Adolph Berrenberg, Somerville, Mass.

447,279. Secondary Battery. Stanley C. C. Currie, Philadelphia, Pa.

447,283. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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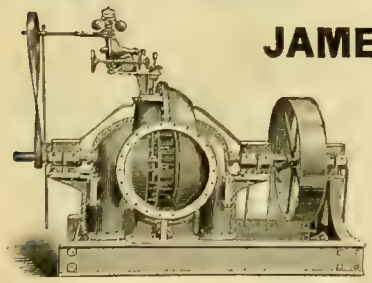

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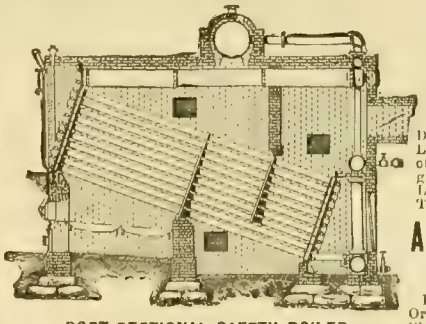

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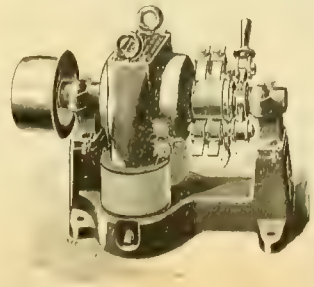

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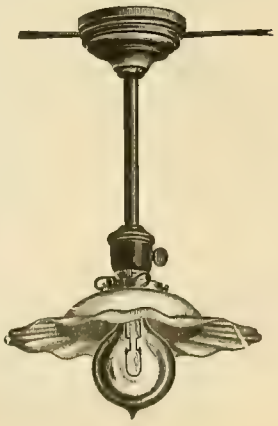

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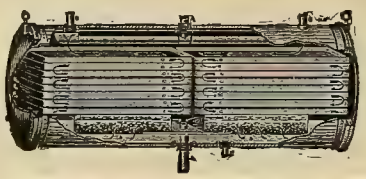

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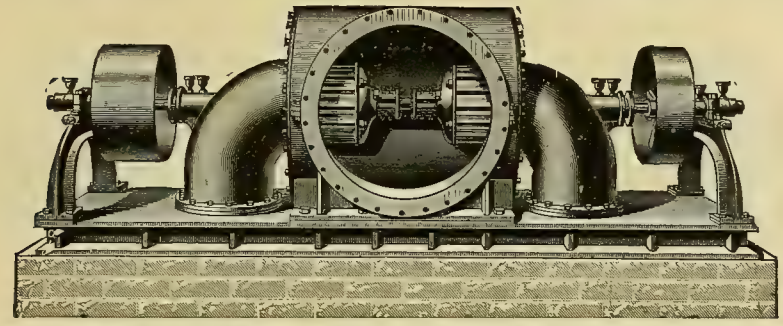

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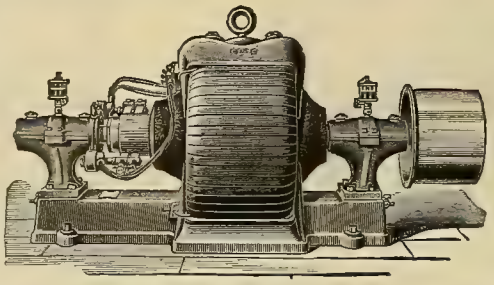

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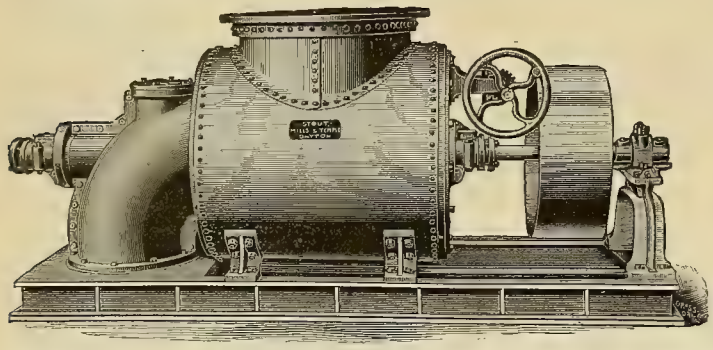

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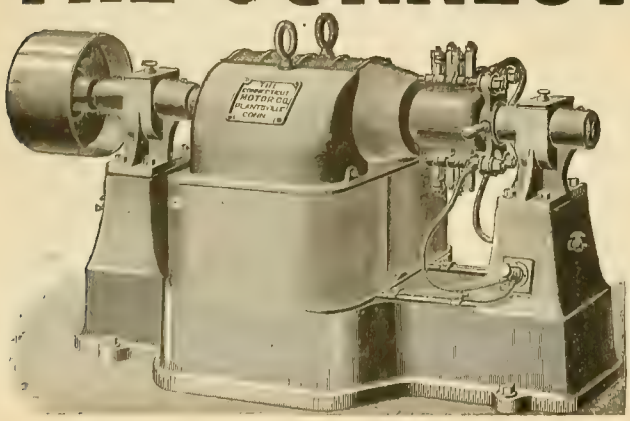

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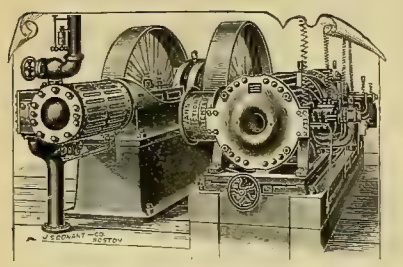

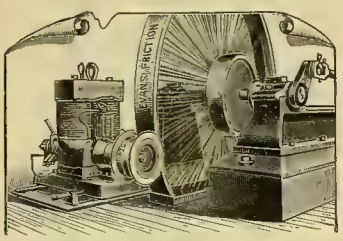

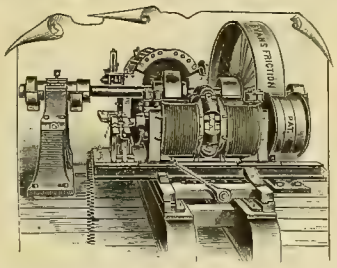

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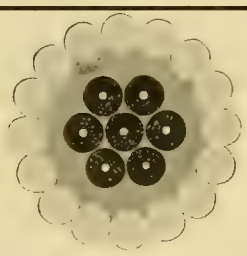

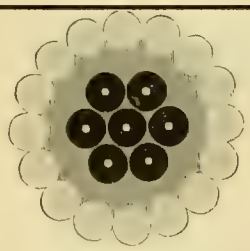

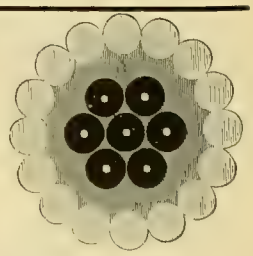

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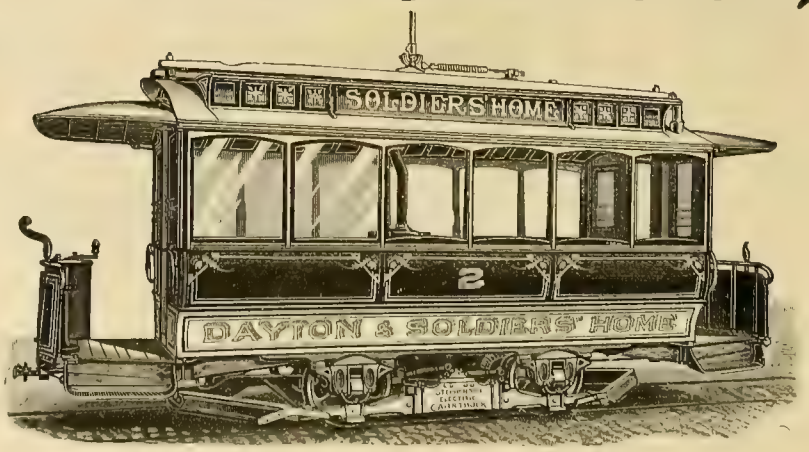

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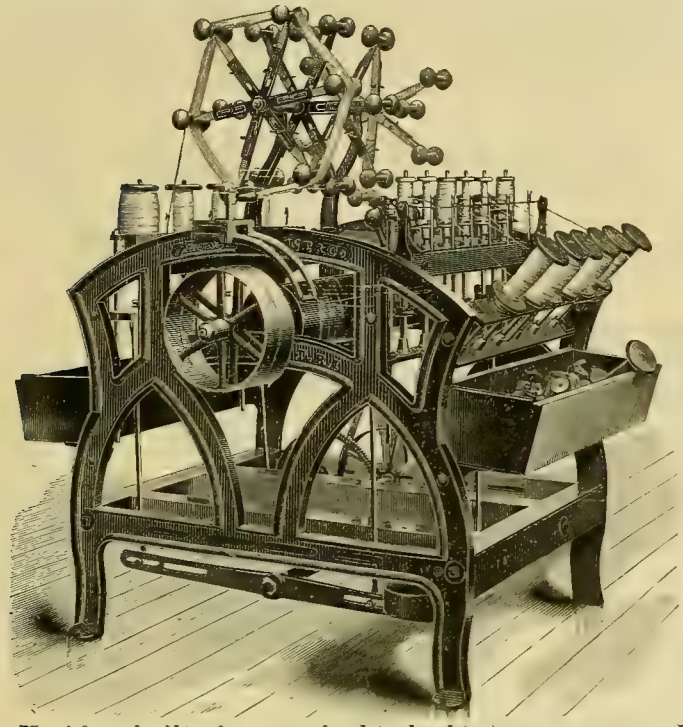

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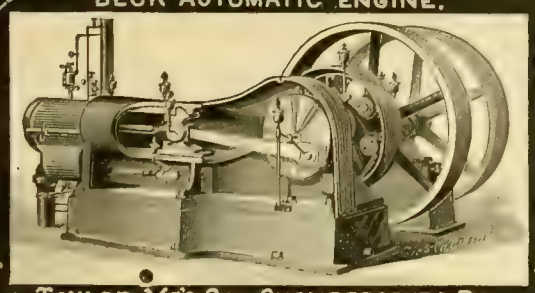

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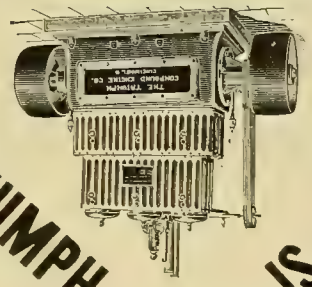

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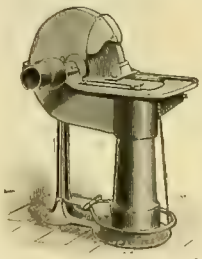

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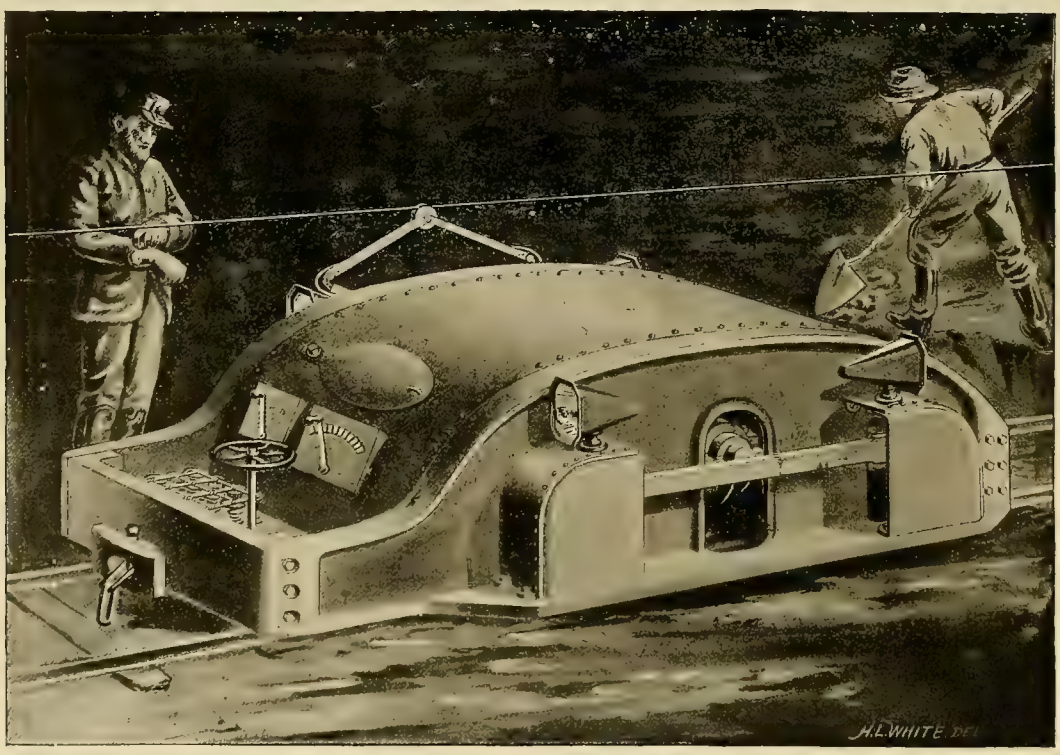

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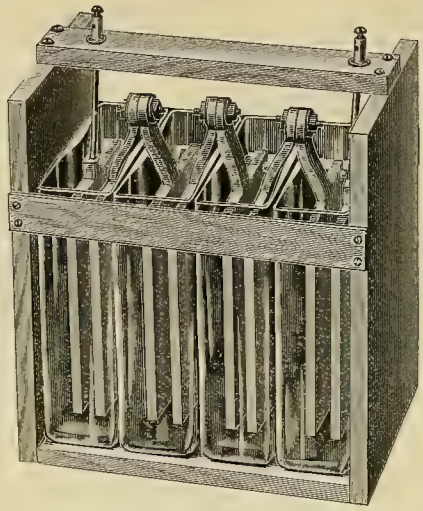
ELECTRO-MOTIVE FORCE TWO VOLTS PER CELL.



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(Signed), G. FRANK LYDSTON, M. D.

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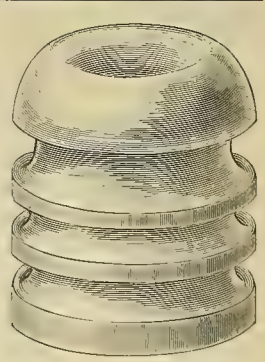
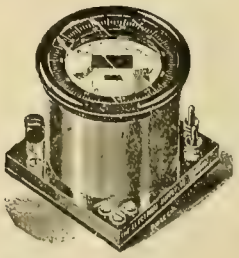
Bassett Combination

Portable and Bracket.



Porcelain Outdoor Insulator.

Wirt Arc Lamp Insulating Hook.



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All other devices are crude, expensive, and unsatisfactory.

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ETC, ETC, ETC.

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OF

Electric Lighting,

THE MOST PERFECT OF ANY.

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Electrical Accumulator Company vs. Julien Electric Company, 38 Federal Reporter, 117.
Brush Electric Company vs. Julien Electric Company, 41 Federal Reporter, 679.

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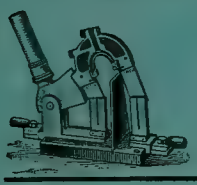

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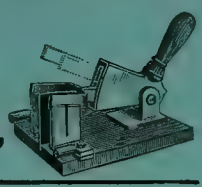

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CELEBRATED INSULATED WIRES AND CABLES.

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INDORSED BY THE UNITED STATES AND GERMAN GOVERNMENTS.

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STEAM AND ELECTRIC EQUIPMENT
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Manufacturers' Representatives.
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SEE PAGE XXVI.

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Sole Agents for the FIBRONE MANUFACTURING COMPANY.

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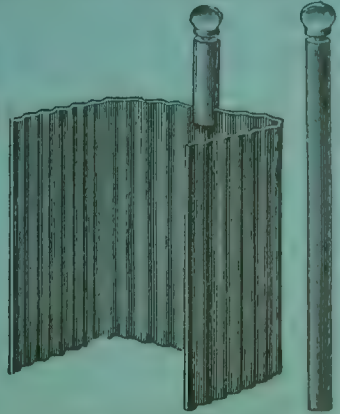
THE TRADE WILL BE PROPERLY PROTECTED.

Complete Cell of Champion Battery.

Carbon Reservoir and Cover of Champion Battery.



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Rod Zinc of Champion Battery.

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Electrical Supplies

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STANDARD ELECTRICAL MEASUREMENT APPARATUS.

$84\frac{3}{5}\%$

91%

$75\frac{2}{5}\%$

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VERMONT,
TENNESSEE AND
WISCONSIN

Were of our manufacture (see table below), as were also

100%

Of the total number of Arc Lights in use in Central Stations in

1 STATE.

The figures referring to "total of all systems," taken from table published in August number of "Electrical Industries," for year 1890, are of undisputed accuracy.	Total of all systems.	Thomson-Houston System.	
		Number.	Percentage to total of all Systems.
Vermont, - - - -	865	732	$84\frac{3}{5}$ per cent.
Tennessee, - - - -	1667	1518	91 per cent.
Wisconsin, - - -	2946	2223	$75\frac{2}{5}$ per cent.

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1333 F Street, Washington, D. C.
115 North 3d Street, St. Louis, Mo.

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Cleveland Aluminum Co.
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Partrick & Carter Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.
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Magnolia Anti-Friction Metal Co., The.
Turner Brass Works.
Arc Lamps.
Bain Electric Mfg. Co.
Brush Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
McLaughlin, Jas.
Northwest Thomson-Houston Elec. Co.
Schuyler Electric Co.
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Westinghouse Electric & Mfg. Co.
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Partrick & Carter Co.
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Evans Friction Cone Co.
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Shultz Belting Co.
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Greeley & Co.,The E. S.
Holtzer-Cabot Electric Co.
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Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Electrical Works.
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(See wire insulated.)
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Standard Underground Cable Co.
Western Electric Co.
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Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.
Western Electric Co.
Cars, Electric Railway.
Stephenson Co., John.
Clutches, Friction.
Hill Clutch Works.
Construction and Repairs.
Bain Electric Mfg. Co.
Electric Construction & Supply Co.
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McLaughlin, Jas.
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Greeley & Co., The E. S.
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Dynamos.
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Bain Electric Mfg. Co.
Colburn & Co., I. W.
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Hawkeye Electric Manufacturing Co.
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National Electric Manufacturing Co.
Schuyler Electric Co.
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Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.
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Central Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Star Electrix Co.
Western Electric Co.
Weston Electrical Instrument Co.
Electrical Specialties.
Cutter, Geo.
Hipwell Mfg. Co., H. H.
Northwestern Elect. Specialty Co.
Turner Brass Works.
Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner.
Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.
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Colburn & Co., I. W.
Edison General Electric Co.
Thomson-Houston Electric Co.
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Engineering Equipment Co.
Noye Mfg. Co., Jno. T.
Pond Engineering Co.
Taylor Manufacturing Co.
Triumph Compound Engine Co.
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Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.
Friction Cones.
Evans Friction Cone Co.
Gas Lighting, Electric.
Cleverly Electrical Works.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.
Wollensak, J. F.
General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Cleverly Electrical Works.
Cutter, Geo.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
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International Okonite Co., The.
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Wilson, Rebenstock & Co.
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Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
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Eastern Electric Cable Co.
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Electrical Supply Co., The.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
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Monitor Electric Co.
Partrick & Carter Co.
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Buckeye Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
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Electrical Supply Co., The.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co , The E. S
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.
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Crocker-Wheeler Motor Co.
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St. Louis Electrical Supply Co.
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Brownlee & Co.
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Great Western Electric Supply Co.
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Electrician Publishing Co.
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Pond Engineering Co.
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Electrical Supply Co., The.
Knapp Electrical Works.
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Knapp Electrical Works.
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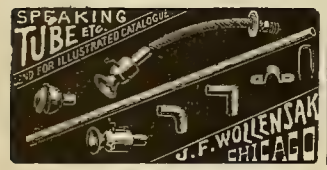

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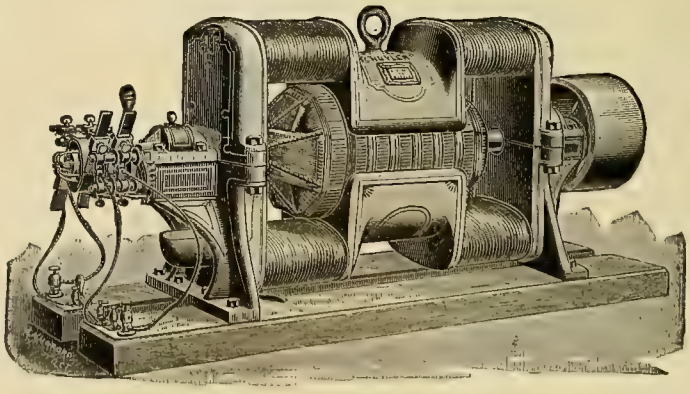

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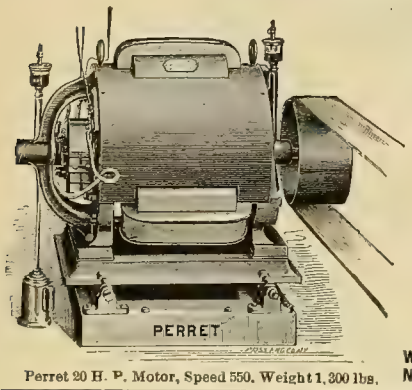

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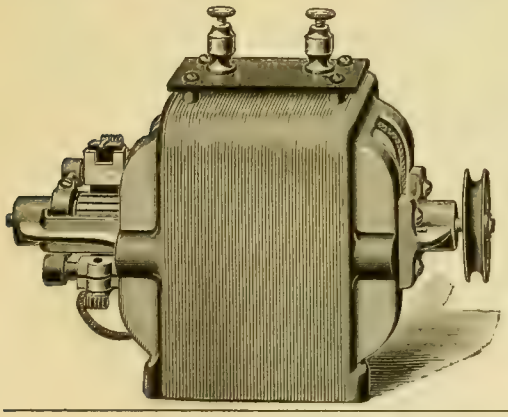

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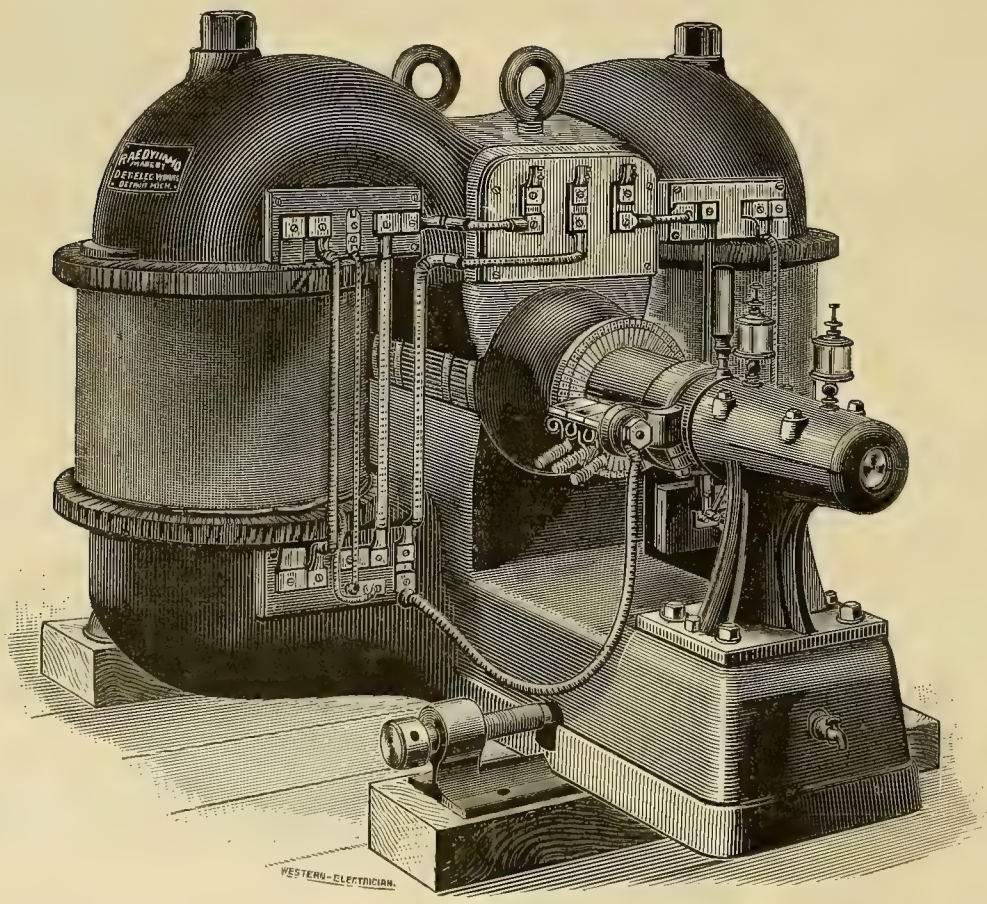

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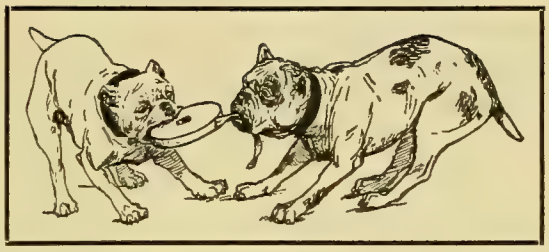

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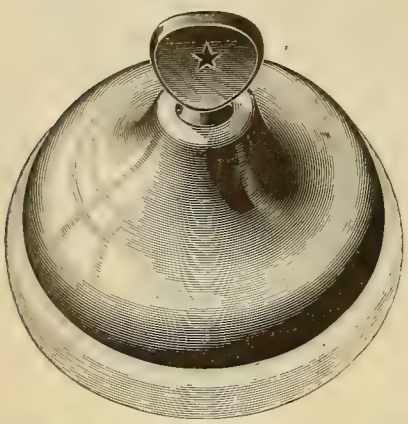

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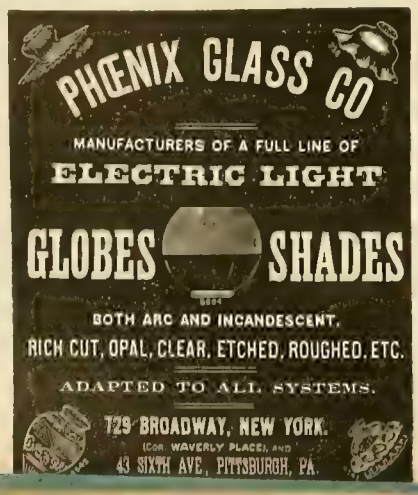

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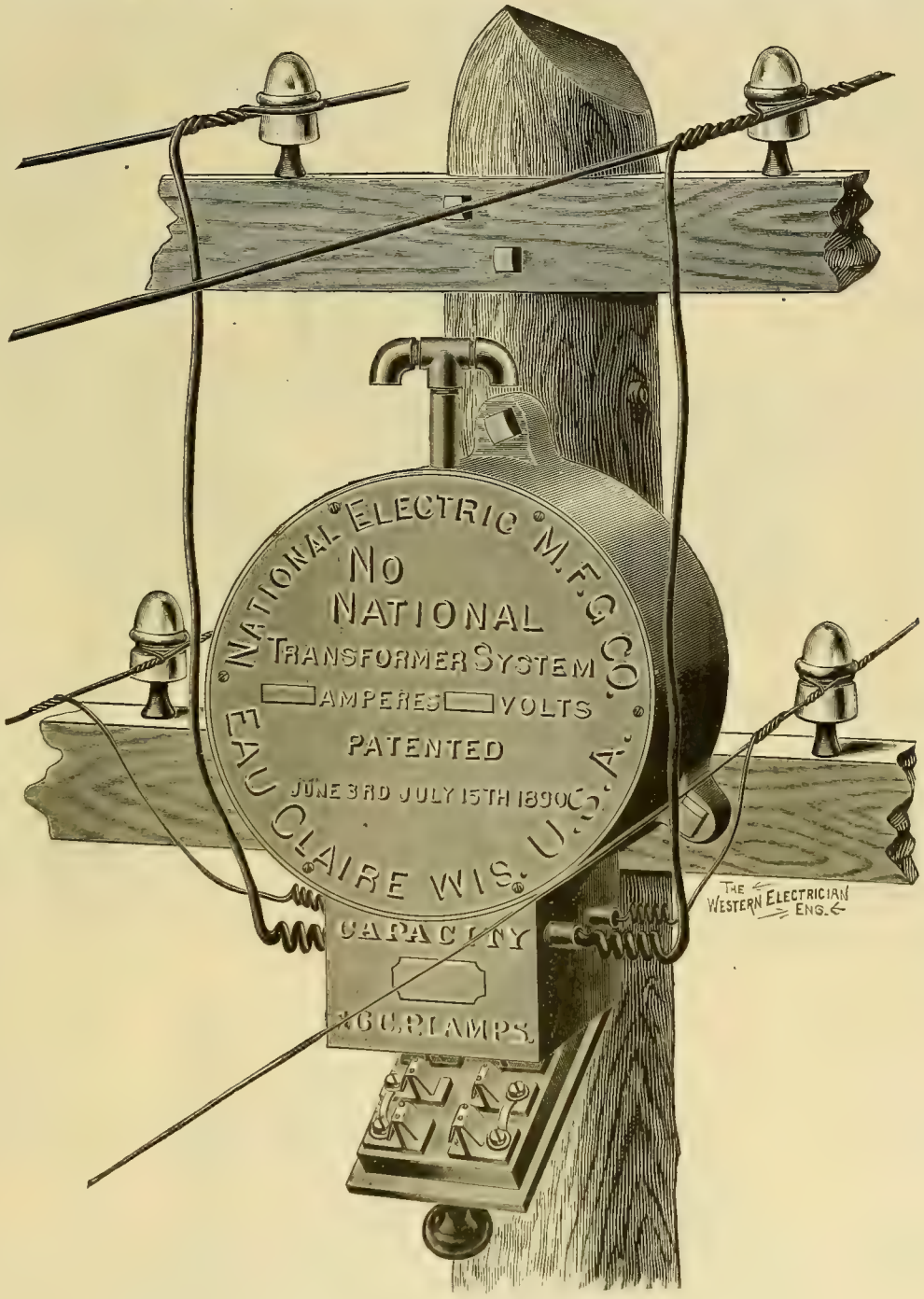

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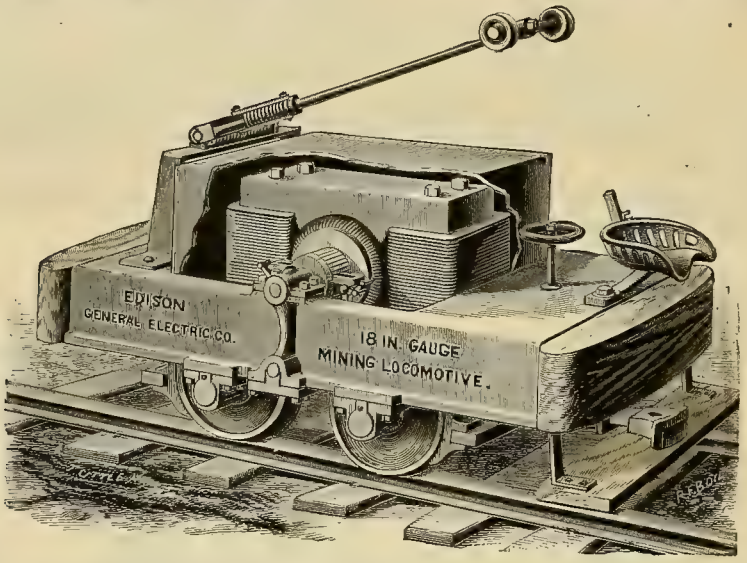

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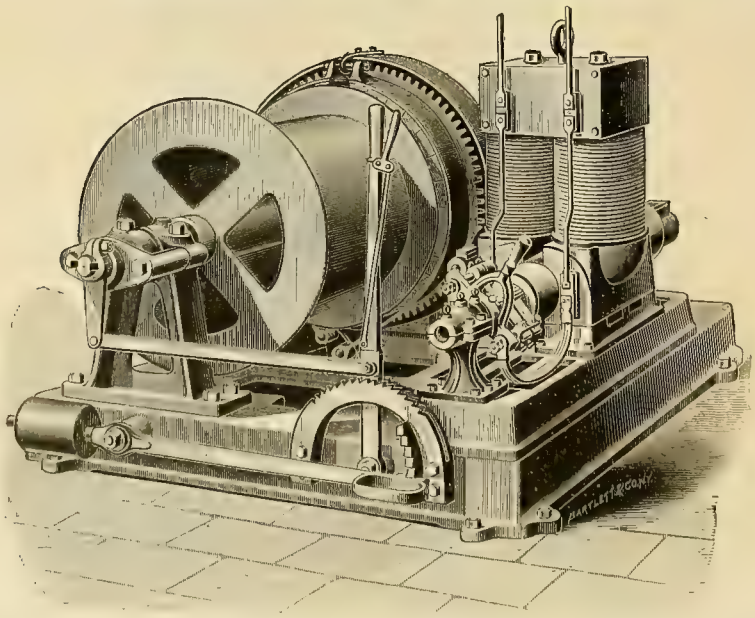

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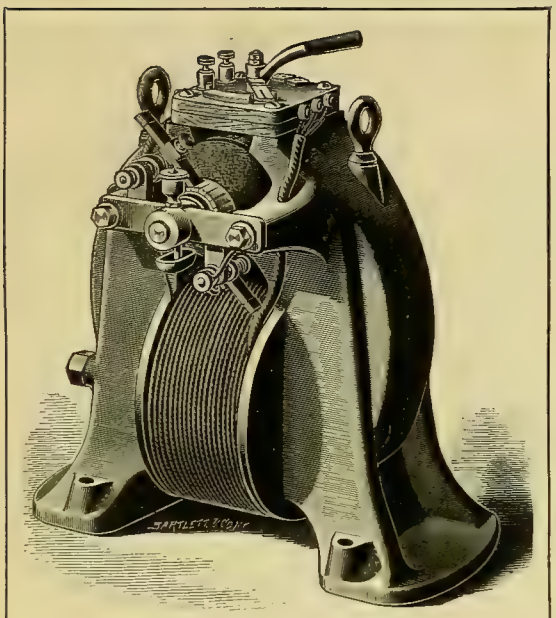

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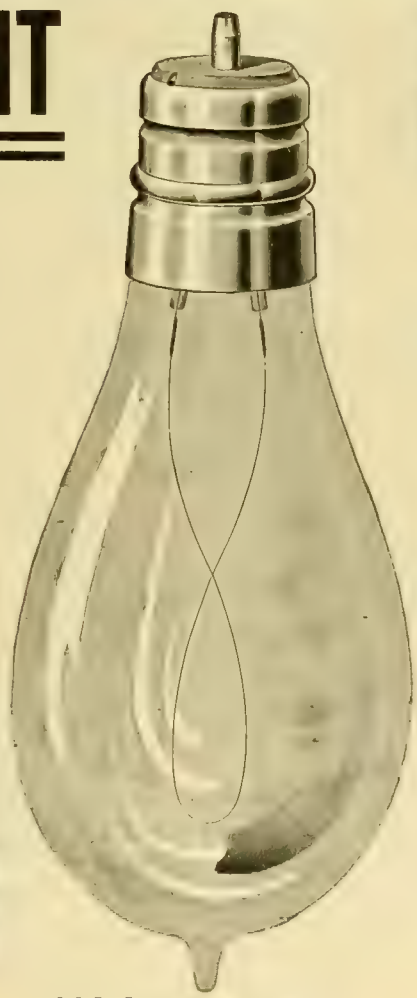

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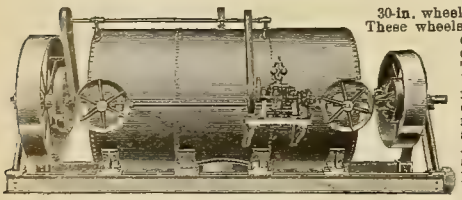

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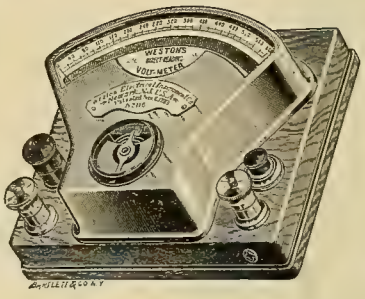

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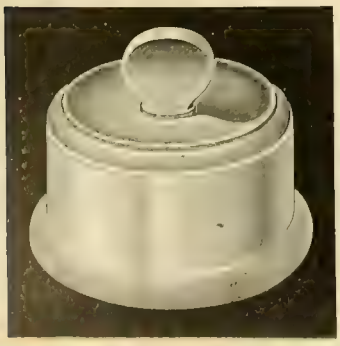

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Vol. VIII. CHICAGO, MARCH 14, 1891. No. 11

Lighting the Train Shed of the Grand Central Passenger Station, Chicago.

In a recent issue of the WESTERN ELECTRICIAN there appeared a description of the Edison plant at the Grand Central Passenger Station, Chicago. On the evening when the station was formally opened to the public a great display of incandescent lamps was made in the train shed and the brilliant effect was much admired. As the installation has been pronounced one of the finest plants equipped in the West by the Edison company, the accompanying illustration, Fig. 1, showing the distribution of the lights in the train shed will be of interest.

In the train shed there are 336 32-candle power lamps arranged in clusters. These lights are so wired that they may be lighted in 10 sections from the dispatcher's office. In this way the shed may be illuminated according to the position of any particular train. The south and north arch of the train shed are each illuminated by 90 32-candle power lamps. The train shed has in all 14 arches and the suspended clusters are wired as represented diagrammatically in the sectional view, Fig. 2. The method of wiring the clusters is a special one and was devised to reduce the danger of short circuits to a minimum. Bearing in mind that bare copper conductors were employed on account of the deleterious effects of the sulphurous fumes from the engines, the method of wiring will be readily understood. In the cut *A*, *B*, *C* and *D* are double and triple porcelain insulators respectively as indicated. Studying the cut closely it will be seen that the cross-over wires on both sides of the shed have the + sign while the middle section is a conductor with a — sign. A little thought will now enable the reader to see the advantage of thus wiring an arch—a broken telegraph wire would have a poor chance of falling across two electric light wires which were not of the same sign, that is either, say, a + wire and another + wire or a — wire and a — wire. The plan of wiring the depot in this manner was devised by Lieut. F. B. Badt.

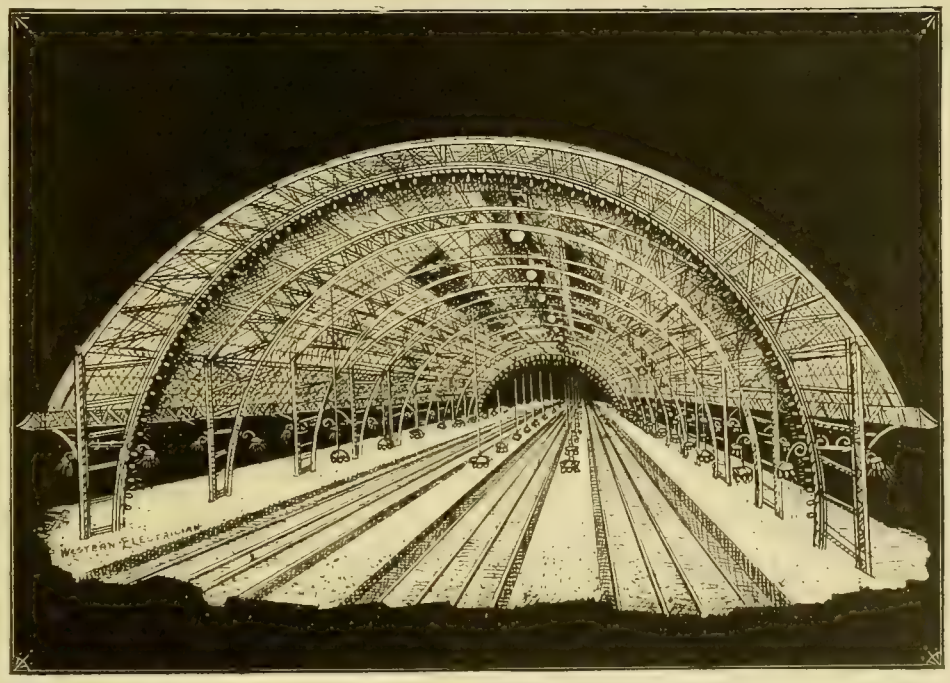


FIG. 1. LIGHTING THE TRAIN SHED OF THE GRAND CENTRAL PASSENGER STATION, CHICAGO.

Appointment of Frederick Sargent.

Of the gentlemen named by the Chicago Electric Club, at the request of Chief Electrician Barrett, for the position of consulting electrician to the chief of construction of the World's Columbian exposition, Messrs. Cutter, Bliss and Grier withdrew their names, leaving Messrs. Soden and Sargent in the field. To these names Professor Barrett added those of Lee L. Summers and C. C. Haskins. These were submitted to the directors of the exposition. The choice fell on Mr. Sargent, whose appointment is announced.

Frederick Sargent is an electrical engineer of ability and experience, and is deservedly popular with the members of the electrical fraternity in Chicago, where he is well known. It is now over six years since he came to this city and engaged in electrical engineering. He had had several years' experience in practical mechanical construction.

Mr. Sargent is an Englishman by birth, claiming as his birthplace Cornwall. He is now thirty-two years of age. Eight years of his boyhood and youth were spent in the works of John Elder & Co., the great ship builders on the Clyde, and there he gained an extensive and practical knowledge of mechanical engineering, paying particular attention to heavy machinery. Coming to America the young engineer found ready employment in Eastern shipbuilding works, and after two or three years he pushed farther west, accepting a position with E. P. Allis & Co., the engine builders of Milwaukee. Here he attracted the attention of the officers of the Western Edison Electric Light company of Chicago, who were in search of an engineer, and in the fall of 1884 Mr. Sargent came to Chicago, and began his distinctive career as an electrical engineer.

After that Mr. Sargent was connected with Edison companies until he opened an office as an independent engineer. He was chief engineer of the Western company, and remained with it about two years, when the parent company bought it out. Then the Chicago Edison company was formed, and Mr. Sargent took charge of its work, first as engineer and then as general superintendent. After two years of this work he went to New York, under contract with the Edison United Manufacturing company. In this position Mr. Sargent had general charge of all the work done by this company in the United States and Canada. Shortly after this the New York company was re-organized as the Edison General Electric company, and the subject of this sketch was made assistant engineer-in-chief of the new corporation. But he had determined to open an office of his own, and last August he returned to Chicago and established himself as an independent electrical and mechanical engineer. He is now in no wise connected with any electric company. He has met with gratifying success in his new field.

Telephone Rates in Illinois.

Senator Thiele's bill providing for a uniform rate of telephone charges is now before the Illinois legislature. Much information on the subject has been collected by the gentlemen at Springfield interested in the proposed law, and it is shown that telephone rates in American and Canadian cities range all the way from $25 to $200 per year. The former sum is the amount charged by the Bell company in Montreal. In that city, it is said, there is lively competition between the Bell company and the Federal company, the latter having upheld in the courts its right to furnish telephone service in Canada. It is said that in consequence of the low rates the two Montreal companies operate 6,500 telephones.

In Chicago the charge is $125 per year, which Senator Thiele would reduce to $80. When Chas. H. Wilson, general superintendent of the Chicago Telephone company, was asked by a representative of the WESTERN ELECTRICIAN what effect the passage of the bill would have on the telephone business in Chicago, he said: "I think that the people of this city want better telephone service rather than lower rates. I feel sure that the people are pleased with the present service, which we have worked hard to make prompt and efficient. We have, in the Chicago telephone system, nine central offices and cover seventy square miles of territory, with nearly seven thousand telephones. All the resources of this system are at the disposal of any subscriber. Last year we spent over $500,000 in improvements, and our switch-board alone cost us $180,000. If the rates were reduced we could not give as good service as we do now, and I do not think the business men of Chicago are willing to accept such a change. People often ask how it is that the rate in, say Springfield, for instance, is $48 a year, while in Chicago, where there is a volume of business so much greater, $125 is charged. It is difficult to make the average layman understand that the telephone business is an anomaly in the laws of trade in that, to a large extent, the proportionate expense of the service increases with the growth of the business rather than diminishes. For instance, a switch-board for 5,000 wires is very much more expensive than fifty switch-boards carrying 100 wires each. And the same principle applies when the cost of wiring and connections for a large territory is taken into consideration. Then again, the $48 rate at Springfield is only for that portion of the city

embraced within a radius of half a mile from the state house. Outside of that $6 is added for every quarter mile. Here we make a flat rate of $125 for our entire territory. So you can see that there are many considerations that do not appear in a statement that should enter into a comparison of the varying telephone rates of cities."

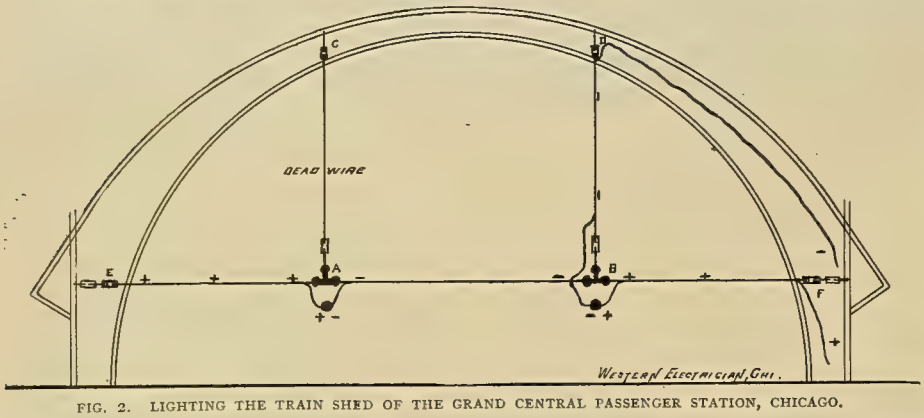


FIG. 2. LIGHTING THE TRAIN SHED OF THE GRAND CENTRAL PASSENGER STATION, CHICAGO.

Underground Electric Railway System.

It seems to be generally conceded that rapid transit can be accomplished in New York City only by means of an underground electric rail way system. During the last few weeks several engineers have proposed systems which have been considered by the Rapid Transit commission. Among the number is a plan worked out by Jesse W. Reno of New York, the general features of which are shown in the accompanying diagram. It is proposed to build four tracks under Broadway from the Battery to Madison square, thence under Fifth avenue to Central Park, the express tracks to turn there and continue under Fifty-ninth street, out Eighth avenue to the Harlem River, while upper tracks continue out Fifth avenue to the Harlem River. The lower tracks will be available for trains of the proposed Hudson and East River tunnels, and will also connect with the Grand Central Railway station in Forty-second street.

The proposed method of construction is ingenious and comparatively simple. The side walls are constructed one at a time in the following manner: A trench three feet in width and thirty-eight feet in depth is excavated outside of the car tracks in the street, and the ground thoroughly supported and braced by a plank lining. The tunnel wall is then constructed by filling in this space with the best concrete. When the wall is built to within eleven feet of the surface the plank lining is removed, the trench filled and the strip of street paving relaid. The other side wall of the tunnel is then constructed in similar manner. At points where the street is crowded a temporary covering of heavy planks can be laid over the opening, which will be about 400 feet long, and the work of sinking and building the concrete wall may go on beneath this, or the ground for the walls may be opened without obstructing traffic at all by sinking a shaft in a side street, out of the way, and drifting along the tunnel line.

The excavation of the ground between the side walls is effected without disturbing the street surface, pipes or subways, by a steel "cutting edge," which rests at each end upon the completed side walls, and is forced ahead by hydraulic pressure, while the channel-steel roof sections are built in behind it, and the construction of the internal steel structure immediately follows.

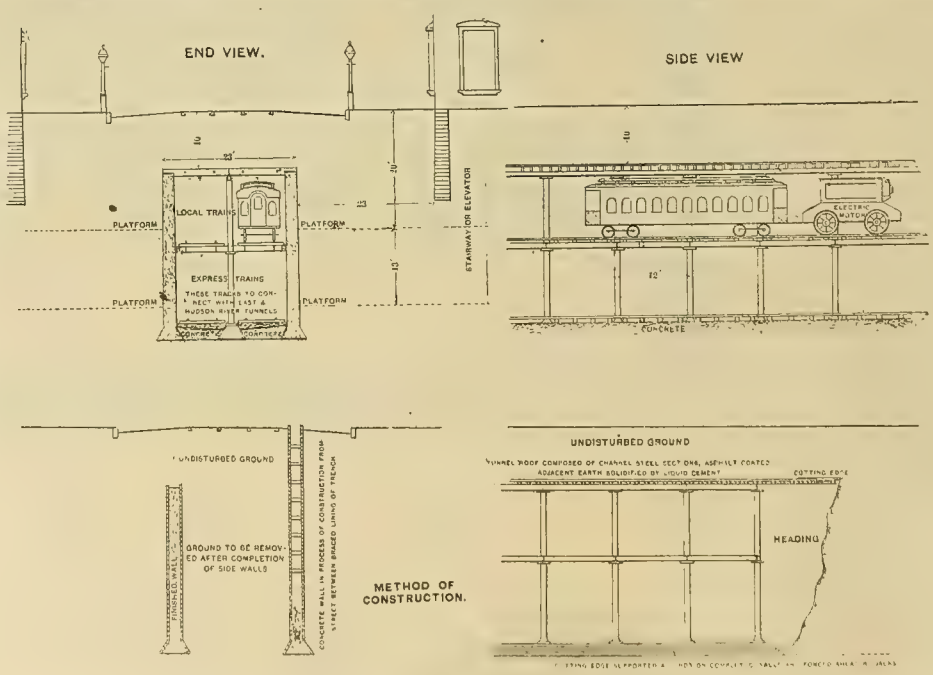
The ground adjacent to the steel roof is solidified by liquid cement forced in under pressure. This, in conjunction with the asphalt-coated steel roof, will insure a perfectly dry tunnel. The row of iron columns, twelve feet apart, through the center of the tunnel support a longitudinal steel girder, upon which rest the roof sections. These iron columns are braced from the side by the transverse girders which support the track beams.

From borings and surveys that have been made in Broadway from Battery Park to Twelfth street, it is known that rock does not come nearer the surface than forty-three feet. At Twelfth street it rises gradually, and at Twenty-third street is eighteen feet below the surface. From the latter point to One Hundred and Fifty-fifth street the average depth of the bed rock is twenty-three feet. The estimated cost of driving this tunnel from the Battery to Union square is $941,000 per mile; above Union square, $1,232,300 per mile.

The advantages claimed for this system of tunnel construction are as follows: The outside width of tunnel being only twenty-three feet, the side walls can be built without injury to foundations of buildings. The line of iron columns through the center of the tunnel permits the use of a flat roof, which may come within ten feet of the surface and yet not disturb pipes or subways. The proposed method of constructing roof and driving tunnel by side channeling and small blasts insures rapid advancement, and will not unsettle the ground surrounding pipes and subways. Station platforms will be easily reached by passengers from the surface; the distance to local train platform being only twenty feet, and to express train platform thirty-three feet. Since there are but two tracks on each level, cars on each can be reached without inconvenience. The transverse girders will resist all pressure of the side walls of the tunnel, and the row of vertical columns through the center divides the span of the roof. The flat roof is especially adapted to the support of an overhead electric conductor, thus enabling the adoption of an electric tramway system. The open spaces between the girders and ties, which separate the two levels of the tunnel, allow free circulation of air between stations, and consequently good ventilation. The facility with which trains can be handled by electricity will be such as to require no loops at terminals.

Three large power stations would be located along the Hudson River, where real estate and fuel are cheap and water for condensing is plentiful. In this way power would be generated, it is claimed, at the rate of two pounds of coal per horse power instead of ten pounds per horse power, as now required on the engines of the elevated railways.

The proposed method of construction will admit of great rapidity in driving this tunnel, as the side walls can be built in advance of the "heading," and all four tracks could be utilized in removing excavated material. With five points of attack giving ten "headings" and an average speed of ten feet per day each, the tunnel proper could be constructed from Battery Park to Fifty-ninth street (five miles), in 264 days. The building of the stations could be carried on while the tunnel is in progress. The form of the tunnel permits of a very convenient arrangement of stations, which are placed at street corners. The platforms are fifteen feet wide and 250 feet long, and the waiting-rooms fifteen feet by forty feet. The latter are entered from stairways, opening in side streets, and provision is also made for elevators. The cut is reproduced from the *Engineering and Mining Journal.*



UNDERGROUND ELECTRIC RAILWAY SYSTEM.

Telephone Bill Before the Pennsylvania Legislature.

The legisluture of Pennsylvania is considering a bill for the regulation of telephone rates. Henry Metzger, general manager of the Bell Telephone company of Pittsburg, appeared before the corporation committee of the senate at Harrisburg, and protested against the introduction of a $36 a year rental bill. This is a bill which was lately introduced in the house for the purpose of establishing a law reducing the cost of telephone service. Mr. Metzger stated that during the last two years his company had spent $300,000 to improve the service, and on account of the electric light wires $25,000 had been spent to get new circuits out of the way of the light wires. He also asserted that men could not be induced to work on the lines when the electric wires are charged, which increases the expense for labor on lines. Referring to the underground system, he said they had already spent $100,000 to bury their wires. The company would have to put $175,000 into a new building, as it could not get along in rented property. Mr. Metzger closed his argument by saying that the company could not do business on a rental of three dollars a month.

An extensive electric line is projected from Dawson, Pa., near Bradford, to Juniata, a new coke town near Connellsville, taking in the towns of Vanderbilt and Liberty. James Cochran, and Colonel A. J. Hill of Dawson are at the head of the movement. The capital stock of the company will be about $200,000.

Power Station of the Missouri Railway, St. Louis.

The Missouri railway of St. Louis, equipped with the Thomson-Houston electric railway system, was put into operation Jan. 16th. This road is sixteen miles in length and extends through the principal streets of St. Louis. The line is a difficult one to operate as there are upon it quite a number of curves, and grades as high as 5 per cent. Thirty-six motor cars and trailers are in service. The road bed is equipped with 52-pound Wharton steel rails with the No. 0 supplementary wire connected to each track, and tie-wires for the return circuit. The overhead construction is of the cross suspension style built on iron poles six, five and four inches in diameter, with the latest design of Thomson-Houston insulators attached to the span and supporting the No. 0 trolley wire.

The cars were built by the J. G. Brill Car company of Philadelphia, Pa., and are 18-foot box cars of the latest improved pattern, tastily decorated and painted and mounted upon Brill trucks. Attached to the trucks of each car are two Thomson-Houston 15 horse power railway motors with the necessary lighting and car regulating equipment.

The power plant, a cut of which is presented herewith, is located near the center of the line. The building is a solid structure of brick, 100 feet long and 80 feet wide, and situated on the line of the steam railroad, so as to make it readily accessible for the reception of freight and coal. The power equipment proper consists of two 500 horse power Harris-Corliss engines. Each of these engines has a fly wheel measuring 22 feet in diameter with a 58-inch face. The wheels each weigh 50,000 pounds and make 58 revolutions per minute. There are four 200 horse power boilers made by Rohen Bros. of St. Louis.

The station is laid out with a main shaft, arranged as shown, and equipped with Hill clutches. To this shaft are belted five 100 horse power Thomson-Houston generators. As will be noticed, these machines are of the four-pole type. Some noteworthy features which the multipolar machine possesses is the slightly lower speed at which it is driven, and the construction of the armature. This last named part of the machine is of the "ring" type, and therefore, dangers arising from a great difference of potential between any two of its conductors, are greatly lessened. Making the armature in the form of a ring also facilitates repairs to individual coils.

The size in use in the Missouri railway plant is termed "M. P. 75." The speed of the armature is 750 revolutions per minute, and the normal voltage of the machine is 500. Four carbon brushes are used. The multipolar machines are separately excited, and the exciter employed is a small dynamo of the Thomson-Houston "motor type."

The switch-board in this company's station, shown in Fig. 2, is said to be one of the finest that has ever been constructed by the Thomson-Houston company. It is thirty-two feet long, eleven feet high, and is made of polished cherry. It has a capacity for instruments for 10 generators and is also equipped with the necessary rheostats, switches, ammeters, voltmeters and automatic circuit breakers. The last named devices are so arranged with levers that they can all be thrown on at the same time.

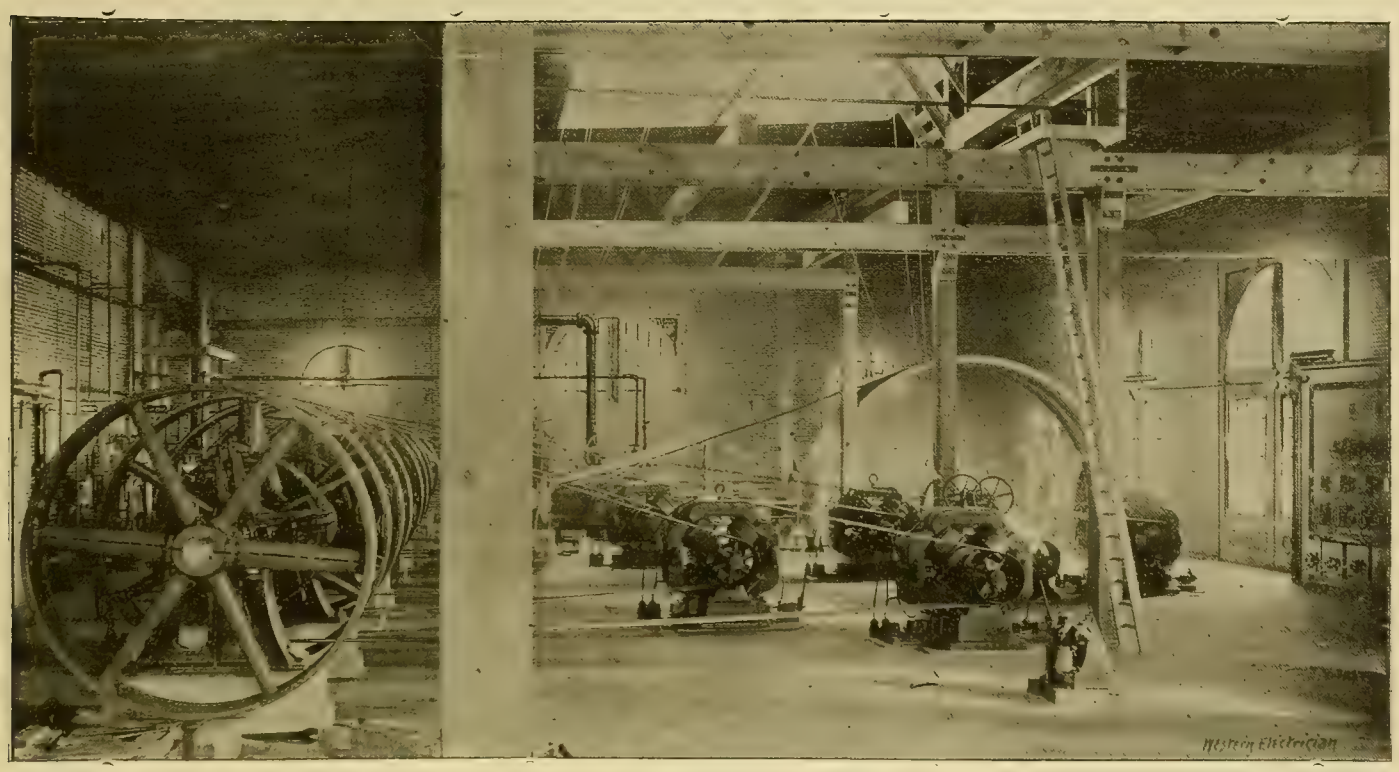


FIG. 1. POWER STATION OF THE MISSOURI RAILWAY COMPANY, ST. LOUIS.

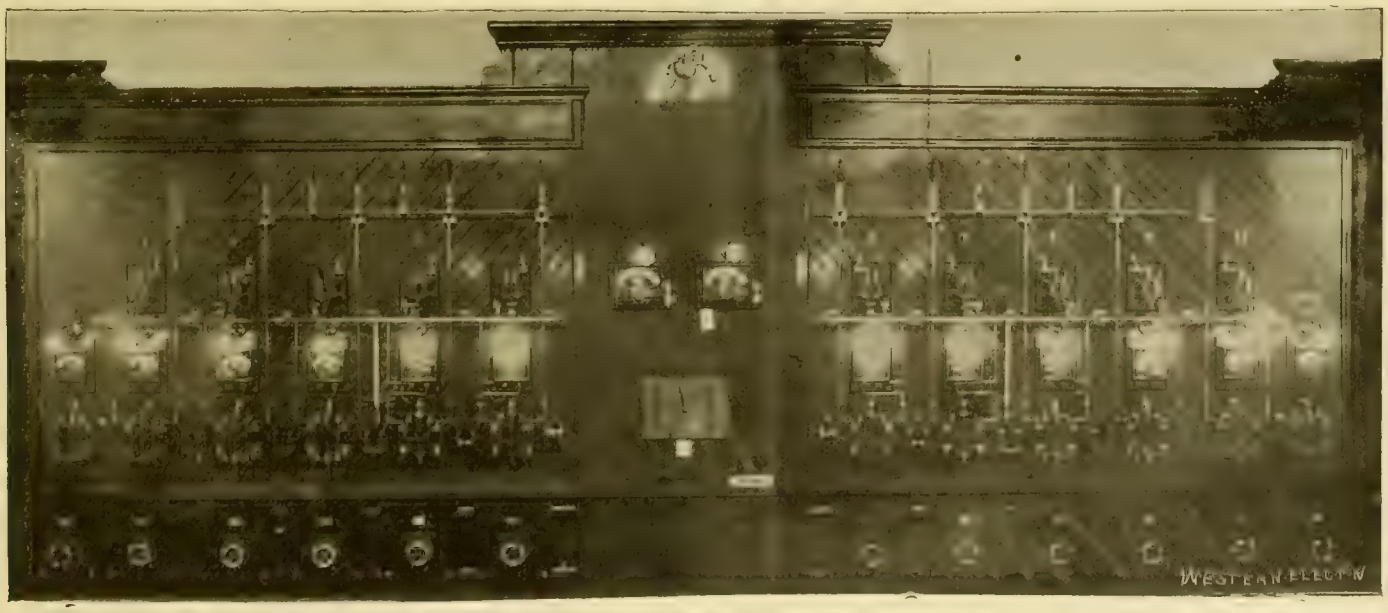
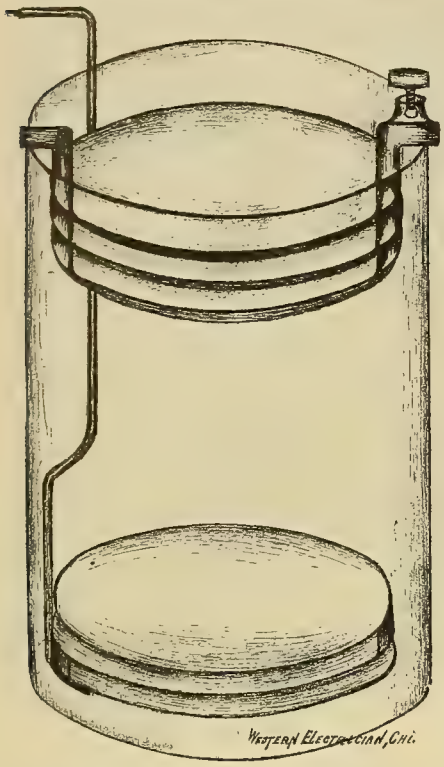


FIG. 2. POWER STATION OF THE MISSOURI RAILWAY COMPANY, ST. LOUIS.

The New England Telephone & Telegraph company has been granted location for its poles in Boston, but with certain restrictions. The poles must not be more than 50 feet high, not less than 15 inches in diameter at the base, and must not carry more than 80 wires and 2 cables.

The Wilson Gravity Battery.

The illustration presented herewith shows the construction of a gravity battery recently invented by D. H. Wilson, Chicago. As will be readily understood, after glancing at the cut, the elements of the cell consist respectively each of three joined disks of copper and of zinc. The sulphate of copper, which, when the battery is in service, surrounds the positive element, is not represented in the illustration in order that the arrangement of the plates may



WILSON GRAVITY BATTERY.

be the more easily understood. The entire negative element, except the lower surface of the bottom plate, is encased in a shellacked canvas jacket. The battery is made in several sizes. The cell intended for telegraph service is provided with zinc and copper disk-elements, five inches in diameter. With plates of this size the battery, it is stated, gives 1 ampere at a pressure of 1 volt. The inventor expects to so perfect this cell that it may be successfully applied to lighting work.

Kennedy's Cable Transformer.

To those familiar with the design of the ordinary commercial transformer, the illustrations shown herewith will present an odd appearance. This cable transformer is the invention of Rankin Kennedy of Glasgow, Scotland, and possesses a number of interesting features.

A glance at Fig. 1 will show that the transformer consists of a cable of insulated copper wires, sheathed with soft iron. There may be any number of wires or strips in the cable. Good results are obtained, it is stated, where

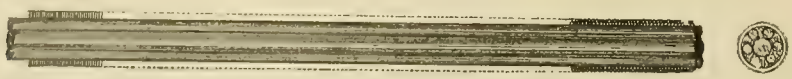


FIG. 1. KENNEDY'S CABLE TRANSFORMER.

only seven wires are used. In Fig. 1 a central insulated wire forms the secondary circuit, and is surrounded by six bare wires forming a primary circuit. This arrangement of wires constitutes the conducting portion of the cable. Next to and around the conductors is placed an insulating covering consisting of, say, cotton, jute, tape or silk. The outside of the cable is a sheathing of soft iron, either of coiled wire, plates or ring disks, of a thickness of from one-eighth to a fourth of the diameter of the seven wire cable.

Mr. Kennedy states that the electromotive force in the cable is directly proportional to its length—that is to say, the force increases from zero at one end to a maximum at the other—so that any desired electromotive force less than this maximum may be obtained by making a connection at proportionally lesser lengths of the cable, as shown in Fig. 2. Thus with a cable of a length giving a hundred volts pressure, an electromotive force of fifty volts could be obtained by making a connection at half-length and still maintain the continuity of the cable and the maximum pressure of the whole length; or the cable may be made in coils of suitable lengths as transformers for any desired electromotive force to be transmitted through them.

In Fig. 3 is illustrated the manner in which the cable is made up in practice, and also how the primary first and then the secondary wires, are connected so as to be in series.

The cable, when used as a transformer, may be coiled or put up into any shape most convenient for packing it away.

American Street Railway Association.

The American Street Railway association will hold its tenth annual convention at Pittsburg Oct. 21st. This association's meetings have come to be regarded as electrical conventions to all practical purposes, and each year they bear additional evidence of the advance electricity is making in this direction. At the last meeting the president announced that it was probably the last convention at which the horse and mule would be seriously considered as a factor in street railway work. This is recalled by the fact that the subject of animal power has not been made a topic for discussion. The secretary announces that the list of committees is complete, and that reports will be presented as follows:

1. A Perfect Electric Motor.—H. A. Everett, secretary East Cleveland Railway company, Cleveland, Ohio.
2. A Year's Progress of Cable Motive Power.—J. C. Robinson, formerly vice-president Los Angeles Cable Railway company, Los Angeles, Cal.
3. Public and State Treatment of Corporations.—G. Hilton Scribner, president Central Park, North & East River Railway company, New York City.
4. The Dependent—Overhead or Underground—System of Electric Motive Power.—George W. Mansfield, director Attleboro, North Attleboro & Wrentham Street Railway company, Attleboro, Mass.
5. The Independent—Storage or Primary Battery—System of Electric Motive Power—Knight Neftel, electrician Lancaster City Railway company, Lancaster, Pa.

Inventors' Celebration.

The committee having in charge the arrangements for the celebration of the beginning of the second century of the American patent system announces that inventors throughout the country are co-operating with it in its efforts to make the celebration befitting the occasion.

Among the many letters of approval received by the committee is one from Edison, saying, "I am in hearty sympathy with the movement." Prof. Alex. Graham Bell has signified his willingness to preside at one of the meetings of the Centennial celebration. The president will preside at the opening exercises and the Hon. John W. Noble, secretary of the interior, the Hon. Frederick Fraley and Prof. S. P. Langley will preside at meetings during the celebration.

The committee on literature has arranged the order of exercises, which will prove one of the greatest literary treats of the nineteenth century. The first public meeting will he held April 8th. A special reception to inventors and manufacturers, and the ladies who accompany them, will be given at the Patent Office, April 8th, 9 to 11:30 P. M., by the Hon. John W. Noble, secretary of the interior, and the Hon. C. E. Mitchell, commissioner of patents.

Special exercises will be held Anniversary Day, April 10th, when the signing of the first American patent law—"An Act to Promote the Progress of the Useful Arts"—by George Washington, will be celebrated. There will be an excursion to Mount Vernon, where an address will be delivered by J. M. Toner, M. D., of Washington, upon "Washington as an Inventor and Promotor of Improvements."

Among the addresses promised at the public meeting are the following: "A Century of Patent Law," by Samuel Blatchford, Justice of the Supreme Court of the United States; "The Effect of Invention upon the Progress of Electrical Science," by Cyrus F. Brackett of New Jersey; "The Inventors of the Telegraph and Telephone," by Thomas Gray, professor of dynamic engineering Rose Polytechnic Institu-

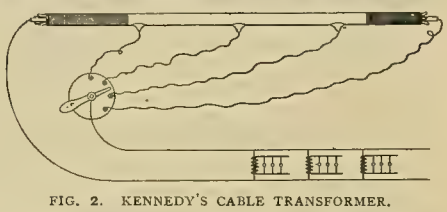


FIG. 2. KENNEDY'S CABLE TRANSFORMER.

tion, Terre Haute, Ind. It is announced that ample facilities for caring for delegates and visitors will be had.

Two Interesting Mid-Winter Electric Storms.

That ever timely topic, the weather, has some very interesting features for the present consideration of the meteorologists. Just now these students are considering the recent storm in the Cape Cod region, which is pronounced the most remarkable ever known. It was a winter thunder storm, but this was its least interesting feature, for these disturbances are becoming quite frequent. When it is considered, however, that thunder storms are rarely so destructive as this was and that in this particular case it occurred during a fall of snow and not of rain, it may be termed remarkable.

According to reports at hand the area over which it was most severe comprised Cape Cod, the shores of Buzzard's Bay, Martha's Vineyard,

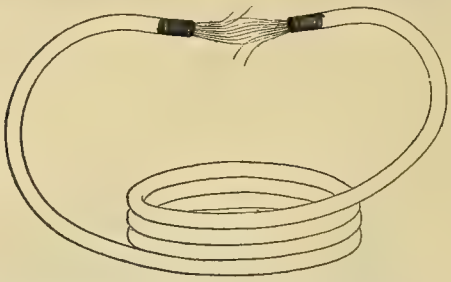


FIG. 3. KENNEDY'S CABLE TRANSFORMER.

and the eastern end of Long Island. A careful examination of the reported accidents by lightning in these districts on the night of March 1st shows that eight churches were struck, six houses, ten barns, one vessel at sea, one life-saving station and one marine signal station. Strangely enough, there appears to have been no loss of human life, although five persons are reported to have been quite seriously injured. Many horses, cattle and swine, however, were either killed by the lightning directly, or were burned to death in the fires kindled by thunderbolts.

The government life-saving station which was destroyed was at Dutch Plain, near Montauk Point. Two buildings were burned, one of them just constructed and fitted up. The marine signal station which was struck by lightning was at Highland Light, in Massachusetts; but the injury there was comparatively slight. The accidents to these government buildings suggest the inquiry whether they were protected by lightning rods or not. If they were, and the rods failed in the time of need, the fact is important and ought to be known. If, on the other hand, there were no lightning rods on these structures, it would be interesting to know why there were not, for lightning conductors are used on very many government buildings, notably on lighthouses.

California has been disturbed recently by a similar experience. Much destruction to electric wires is reported by our San Francisco correspondent, and in other parts of the state it

is said that accompanying a fall of snow there was a thunder storm. As evidence of this fact there is recorded the destruction of a house in Vacaville, during the storm. Snow and sleet themselves are rarely seen in California and it is scarcely to be wondered at that much interest is felt on the coast at the combination of a snow and thunder storm.

The Patent Office.

Inventors generally are interested in the organization and workings of the patent office. Electrical inventors have a special interest in this department, for in no other branch is such rapid advance being made as in that of electrical science. It is therefore specially desirable that the electrical section of the patent office should be well equipped and that every facility for expediting matters be offered the examiners. It is well known that the patent office has been neglected; that the quarters allotted the department are not suitable and that the examiners are constantly changing. The WESTERN ELECTRICIAN has called attention to these defects frequently, and also to the fact that the service in the patent office was necessarily inefficient. This position is sustained by Park Benjamin in an article in the *Forum* for March. He calls attention to the fact that the patent office is not only self-sustained financially, but is paying into the treasury a surplus revenue of nearly $230,000 annually. Its accumulated profits over and above all expenses, including the cost of its building, only a part of which it is permitted to occupy, now form a fund of nearly $4,000,000. All of this vast amount has come out of the pockets of inventors, and not one cent from those of tax-payers at large. The inventors, therefore, and not the general public, maintain—and more than maintain—the patent office. They have a right to demand the most efficient service that it can give them, for that is what they pay for.

Here is an abstract from Mr. Benjamin's article: "The presiding officer of the patent office is a commissioner who, to meet all theoretical requirements, would need nothing short of omniscience. He is a judicial officer, an executive officer, a legislative officer, and an accounting officer, all in one. As a judge, his jurisdiction is both original and appellate. As a law-maker, he devises rules having the force of statutes, subject only to the perfunctory approval of the secretary of the interior. As an executive officer, he regulates and controls the ministerial affairs of the patent office, and commands its 589 employes. As an accounting officer, he receives the immense sums paid into his bureau and accounts for them. He is presumably an expert in every branch of applied science, a skilled mechanic, a consummate electrician, and a chemist of high ability; and, perhaps, he ought also to be a "lightning penman," seeing that about one-tenth of his time is wasted in the clerical work of signing patents. Of all the bureau officers that have power to nominate persons to a cabinet minister for appointment, he is the only one without whose nomination the minister cannot appoint. This superior being, vested with all these multifarious capacities, we expect to obtain for the sum of $5,000 a year; which is perhaps the most remarkable fact of all. We do not get him. To make sure that we shall not, we have converted the office into political spoils, and we have filled it, not infrequently, with lawyers from the cross roads and with experts from the stump.

"By a fiction of law, the commissioner is supposed personally to know all about the 40,000 applications that are filed every year. As a matter of fact, he probably hears of about one in fifty. They are handled by a corps of examiners, who are graded in various ranks in a semi-military manner. The principal examiner in each division is a judge of first instance for the decision of all questions of law and of fact affecting an application. No matter how enormously important an invention may be, no matter what great interests are at stake upon the possession of the patent which is to secure it, the whole matter is subject to his supervision. He may harass and hamper the inventor with restrictions and keep him waiting for years. He may grant illegal and improper claims, and so subject the public to vexatious litigation, and seriously impede the progress of great industries. It is true that the inventor may appeal from him, and thus secure rights improperly denied; but there is no redress for the public, against the allowance of a bad patent, other than in the courts. The men upon whose shoulders we place these great responsibilities are paid the wages of young naval lieutenants or of ordinary book-keepers—$2,500 a year.

"There are also 169 assistant examiners, who are presumably competent scientific experts, but who receive clerk's wages—from $1,200 to $1,800 a year. They are mostly young men. Washington possesses four large law schools where evening instruction can be obtained, and the utility of a government position which at once furnishes a support and a chance to practice law on the inventor, is plain. Tenure of office is therefore shortened, not merely by inadequacy of salary, but by the resignations of incumbents in all grades, from the commissioner down, to enter practice as patent attorneys when sufficient education has been obtained. The evil is twofold; first, the patent office is converted into a training school, so that the service becomes inefficient; and, secondly, there is nothing to prevent the retiring official from taking with him, and using for the benefit of private clients, copies of pending applications or other secret information, the revelation of which may be highly valuable to one competing interest and correspondingly injurious to another. This has been done; it should be made impossible. A law in other departments prevents a former government employe from practicing before the office in which he served, until two years after the end of his term of service. A similar term of incapacity should be imposed on ex-officials of the patent office.

"There is also in the patent office an extraordinary tribunal charged with determining 'interferences,' or issues of priority between rival inventors, and presided over by an examiner paid as inadequately as the others. Here occur probably the bitterest litigations in the world, for the fight of an inventor for his invention is like that of a tigress for her whelps. The practice of the tribunal is governed by the equity rules of the United States courts, and it enforces technicalities to a degree which finds a parallel only in criminal cases. Neither the judge nor the attorneys are necessarily lawyers, and the court decides matters of law, fact, and metaphysics with equal readiness. The decision of the commissioner, on appeal, is final between the parties. But as the defeated contestant frequently infringes his adversary's patent after it is issued, the whole controversy may be fought over again in a court of law—a condition of affairs much needing reform. Between the commissioner and the primary examiners is an appeal board of three examiners-in-chief. The pay being not glaringly insufficient and the position one of some dignity, its incumbents are usually men of ability and hold their places for long terms.

"The remainder of the patent office employes, mainly clerical, number about 400. The entire working force is crowded into about one-half of the available space in the so-called patent office building—the whole of which the inventors have paid for, as before stated—the rest being occupied by the Interior Department, of which, for some inscrutable reason, the patent office is a bureau. The quarters are so inadequate that the most valuable records of the office lie piled up on floors and in corridors, despite the lesson of two disastrous fires. The average floor space given to each employe is about seven feet square, no allowance being made for passage ways. Most the occupied area is taken up by halls for the exhibition of old models, which are interesting chiefly to Western bridal couples

"The patent office has been of the greatest benefit to the country, and despite its defects, it is so still. It cannot be brought to higher usefulness, and it is even doubtful whether its present condition of impaired efficiency can be maintained, without material, and probably radical improvement. We want for its proper administration the best attainable scientific and legal talent, and plenty of it, sufficiently and reasonably paid, and intelligently directed. We want uniform and stable decisions and uniform practice. We want permanence in office, and attorneys subject to proper restrictions and discipline. We want adequate facilities for research of every kind, and adequate room for work and storage. We want every possible safeguard against temptation, corruption and fraud. We want the appropriation of the surplus revenue of the office to the purpose for which it was given. Most of all, the people should understand that the patent system is not an institution for the imposition of grinding monopolies. It protects the inventor in what is his by right of creation and discovery; and by the stimulus which it affords to invention, it cheapens the necessaries and increases the comforts and conveniences of life, augments their consumption, redistributes labor, calls forth higher orders of skill, and opens new avenues of employment."

Overhead Wires in Rochester, N. Y.

At the Providence convention of the National Electric Light association the committee on underground conduits and conductors presented some interesting figures furnished by the Chicago Arc Light & Power company. The following report from the Brush Electric Light company of Rochester, N. Y, will prove interesting in this connection:

Number of circuits	29
" miles overhead wires	315
" of arc lamps	1334
" " Bernstein incandescent	132
" " Swan "	200
" " motors	549
" " grounds during 1890	32
" " times wires broken, 1890	3
" " employes	49

Amount of rebate allowed during 1890, one hundredth of one per cent. of gross receipts.

Amount of uncollected amounts 1890, one-tenth of one per cent. of gross receipts.

It was found necessary to shut down only two circuits on account of grounds; the others were located and repaired before the circuits were started.

The report further states that the three breaks in the wires reported were caused first by a careless carpenter, who cut the wire with a hatchet, the next by a trimmer stepping on a tie wire, and the third by firemen.

This is certainly an excellent showing, and it serves to illustrate the fact that good overhead construction can give excellent results. The Rochester company recognized this fact at the beginning of its career, and it has conducted its business in accordance with that policy. It has gained an excellent reputation throughout the country, which this report will serve to confirm. Moreover, in Rochester the company is respected for its business like methods. Its officers are: George E. Mumford, president; Charles B. Griffith, secretary and treasurer; George A. Redman, superintendent and electrician. They are to be congratulated on their excellent showing.

Electric Funeral Trains at Pittsburg.

Pittsburg is soon to have electric funeral cars. The stockholders of the Suburban Rapid Transit Electric Railway company of that city at a recent meeting decided to place several cars at the disposal of funerals. There are seven cemeteries on the line which is traversed by the system of the company, and at least five funerals take place every day. This, of course, would make the proposed investment an excellent financial venture, so far as the electric railway company is concerned, inasmuch as it would compete successfully in conveying the funerals much cheaper to their destination in the matter of charges than the livery man. The company has decided to have two cars especially built for funeral purposes. These cars are to be painted black, and they will of course be equipped with electric motors. The introduction of these cars will no doubt prove a boon to poor people, because carriages at the present prices make even a small funeral very expensive, whereas the use of the electric road would place the expense within the reach of all.

The Pittsfield, Mass., Street Railway company has ordered four electric cars, to be operated by the overhead system. The necessary apparatus is to be furnished by the Westinghouse company, and is to be in operation early in summer. Iron poles will be used in the center of the city.

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W. A. KREIDLER, - - - - - - - - - Editor and Publisher.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - - Associate Editors.
W. E. KEILY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.
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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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ELECTRIC railways have a legal existence in California. In the last issue of the WESTERN ELECTRICIAN an interesting account of the fight over the electric railway bill in the California legislature was presented in the San Francisco letter. The governor has since approved the bill, and electric railway men are accordingly elated over their victory.

TWO prominent electric lighting companies of New York City have begun actions against the city to recover the damages sustained by them through the warfare waged by Mayor Grant, the Board of Electrical Control and the commissioner of public works. It will be remembered that at the time the poles and wires in New York were so indiscriminately attacked by the city authorities the companies warned the mayor that they would hold the city responsible for all damages sustained, and prominent lawyers at that time said the city officials had exceeded their authority. The public clamor, however, against the electric companies had more weight with the politicians who were directing matters, and the common sense of the community was disregarded. Now, when the mayor finds an important litigation on his hands he may realize that the temporary advantage gained was hardly worth seeking. If the city of New York should have a million dollar verdict rendered against it it would be just retribution.

IN this issue there is an important and highly instructive lesson presented in the report of an electric lighting company at Rochester, N. Y. This corporation is one of the most successful in the country, its service is pronounced first-class in every respect, and it has the confidence of the community—yet it is operating overhead wires. The explanation is easily found. The company's construction work has always been first-class in every respect. This experience shows that overhead wires, when properly constructed, can be operated with safety—in fact that there is no reason why the electric lighting companies in cities of the size of Rochester should be compelled to go underground. If the companies do good work at the start and continue in the same line, there should be no trouble with the community which they serve.

ANOTHER interesting decision in a telephone case is reported from New York. It is said that Judge Ingraham has ruled in an injunction proceeding against the Metropolitan Telephone and Telegraph company that a certain street in which the corporation wanted to string its wires, was opened under the act of 1813 for specific purposes, and that the use by telephone and telegraph companies was not a street use. It had been held that any such use of the street without acquiring the interest of abutting property owners was a private nuisance, and that any person entitled to enjoin such use might do so. In the case under consideration the company had failed to secure permission from property owners for the stringing of its wires. In many streets in New York in which there are no subways, the people are practically cut out of telephone service. They will not have the wires strung on housetops, and the city will not consent to further pole lines.

IN the numerous discussions relative to the electrical department at the World's Fair it is a noticeable fact that but little has been said about electric railways. Sketches of a building which, it is understood, is to contain the electrical exhibits are being prepared, and it seems certainly not an untimely question to ask in what manner it is proposed to provide for the railway exhibiters. Are the several systems of electrical propulsion all to be exhibited within-doors? Or, will those of the electrical companies which are desirous of making creditable exhibits, be provided space on the outside? These questions may be considered by some premature, but if the electrical department is to be the grandest the world has ever seen, the display of electrical systems of power transmission will play a most important part. Suggestions have been called for, and many excellent ideas have been presented, but has there been any direct communication with those who may consider space on the outside most desirable? It is understood that an elevated road will be erected on the Fair grounds, and that it may, perhaps, be operated by electricity. But why do we not hear that the exploiters of electric street railway systems have asked for space on the grounds on which to display their apparatus in practical operation? The reader will, perhaps, remember the electric railway exhibits at the meeting of the National Electric Light association in Chicago, 1889. With years for preparation, will the Fair show us the electric railway systems of the world in an exposition building, or will there be an extensive system of electric roads in operation about the grounds?

DURING the last year and a half there has been considerable interest manifested in the Weems' electro-automatic railway system. A company, it will be remembered, was organized with the intention of working out a system for the transportation of parcels or passengers at a high rate of speed. Up to the present time few of the details of the experiments made by this company have been given to the public. In this issue is presented a paper by O. T. Crosby, who was in charge of the company's engineering work. This paper is a "Report of High-Speed Electric Railway Work," read before the American Institute of Electrical Engineers, and contains a detailed account of his tests and work. Mr. Crosby's reputation as an electrical engineer is sufficient guarantee in itself that the report is reliable and contains matter of value. It is interesting in connection with this report to call attention to a remark made about six months ago by David G. Weems, the prime mover in the enterprise. In an interview with a representative of the WESTERN ELECTRICIAN Mr. Weems said, speaking of proposed changes in the system, "We have discarded the elevated structure, as it would cost too much to build a framework which would stand the strain with such a speed as our trains will attain. * * * We do not require any special construction as far as rails are concerned. We can use the ordinary standard rail. The weight of the train will keep it on the track." In reading Mr. Crosby's paper it will be noted also that he remarks, "The time limitation of the runs was invariably caused by failure of the track to serve its purpose." These admissions tell the story. It has been repeatedly demonstrated that one of the most essential factors in even a comparatively slow-speed electric railway is a solid and substantial road-bed and track, and the fact that in developing Mr. Weems' plans it was found necessary to do away with the elevated structure, only goes to show that the success of an electric railway is dependent upon a number of other things besides the mere electrical equipment.

THE organization and administration of the patent office is of great importance to the public generally, though only inventors and others brought directly in contact with the department seem to realize this. At any rate, the general public concerns itself little with this important matter, so far at least as following the workings of the office. At Washington, outside the department, the patent office is prominent only when an effort is made to secure an appropriation for the purpose of increasing the efficiency of its administration. When it is considered that this department not only is self-sustaining, but that it pays into the treasury every year a large sum of money, and that this surplus has accumulated until it comprises a handsome sum, nearly $4,000,000, it may be wondered why those who are directly interested in the subject should not insist upon the expenditure of the income of the department in promoting its efficiency and securing better accommodations and facilities. There have been several occasions during the last few years when complaints have been made against methods employed, and so glaring have been some of the mistakes that public attention has been directed to them.

The policy of making the patent office a source of revenue to the government has always been condemned by the WESTERN ELECTRICIAN. We have contended that the charges should be limited to the cost of making researches and such other expenses incidental to the issuance of patents. Furthermore, we have contended that the present service was poor, and that the real cause of the trouble was the system on which the department is based and conducted. Better salaries should be paid, and the standard raised. At the present salaries the patent office can only continue to serve as a training school for young men looking for experience in patent law practice. It is impossible to get good results when the force of examiners is constantly changing. As soon as a man becomes valuable he can command greater compensation elsewhere.

In the March number of the *Forum* Park Benjamin takes up this question and follows the same line of argument we have suggested. His intimate knowledge of the details of the office give him an excellent opportunity to disclose the weak points and suggest permanent improvement in the service. There are many bad features about the present system, and it is to be wondered that more abuses of power have not been committed. A careful perusal of the abstract from Mr. Benjamin's valuable article will benefit all who are interested in electrical inventions.

Report of High-Speed Electric Railway Work.[1]

By O. T. Crosby.

The experiments here reported were the first serious efforts ever made to at once double railway speeds, and as such should, I think, be systematically recorded. They were made for the Electro-Automatic Railway company of Baltimore, Md. This company was organized about four years ago by David G. Weems who, though not an engineer, was convinced that the electric motor would give very high speeds for the transportation of parcels. His persevering enthusiasm resulted in inspiring a number of gentlemen to subscribe money for the venture.

Mr. Weems first contemplated having an entirely automatic service from city to city, the cars to be smaller than would be necessary for placing a man.

For purpose of demonstration, a circular track nearly two miles in circumference was laid at Laurel, Md ; gauge 28 inch; weight of rail, 16 lbs.; shape, T; cross ties, 3x4 inch square, 16 inches apart. Wooden stringers 3x4 inches, were laid outside each rail, serving as guards. Mudsills, 3x4 inches, were laid under the ties, and to the ties was built up a vertical framework on both sides of the track, this carrying from cross-pieces 2x6 inch wooden stringer, suspended above the middle of the track, while to the lower surface of the stringer was attached a small Trail, head down. This upper rail was intended to serve as an electric conductor, and also, in connection with upward pressing wheels, as a guide. The latter function was not successfully performed, the lateral oscillation of the car on so slight a track, being too great. Part of the track was on trestle work crossing a swamp, the overflow of which caused frequent washouts.

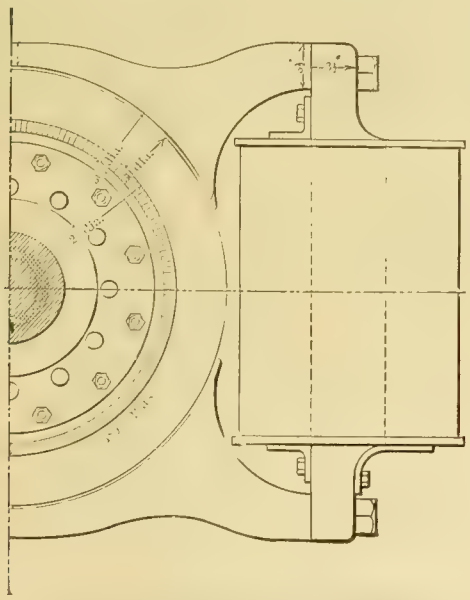

FIG 2. HIGH SPEED ELECTRIC RAILWAY WORK.

The locomotive was very simple. Three axles carried 28 inch wheels; on these were hung a steel box, 16 inches long, 24 inches high x 30 inches wide. A slight vertical play of the box was provided for by the springs, but, horizontally, the three axles were in rigid connection. On each of these axles it was designed to place a motor. The head was pyramidal; the weight of the car with three motors was about three tons. A second similar box of steel was made to be drawn by the motor-car, the two to be connected by a ball and socket arrangement, the interval between cars to be flanged over so that only one surface should be presented to meet atmospheric resistance. The tail was pyramidal. The second car was not in use more than once.

[1] Read before the American Institute of Electrical Engineers, Feb. 24, 1891.

The track-work and cars were completed as above outlined when the matter was brought to the Sprague Electric Railway & Motor company, with the request that they design motors of which the armatures should be placed directly on the three driving axles of the car, the construction of which was already nearly finished. It was further conditioned that the motors should do 20 horse power of work each at a normal speed of about 3,000 revolutions per minute. This corresponds to a car speed of about 250 miles per hour. Needless to say, that on so light a track, none of which was straight, and with a car weighing three tons, and with only 60 horse power available for work, no such speed was attained. The motors were carefully designed by H. F. Parshall of the Sprague company for a normal impressed e. m f. of 500 volts, and thoroughly filled the specifications. They were to be connected in multiple across the 500-volt circuit supplied with current from a dynamo made by the Edison Machine works. When the motors were finally mounted and ready for action it was found almost impossible to start the car, due probably to stiff bearings, and when several trials of speed had been made the results were disappointing.

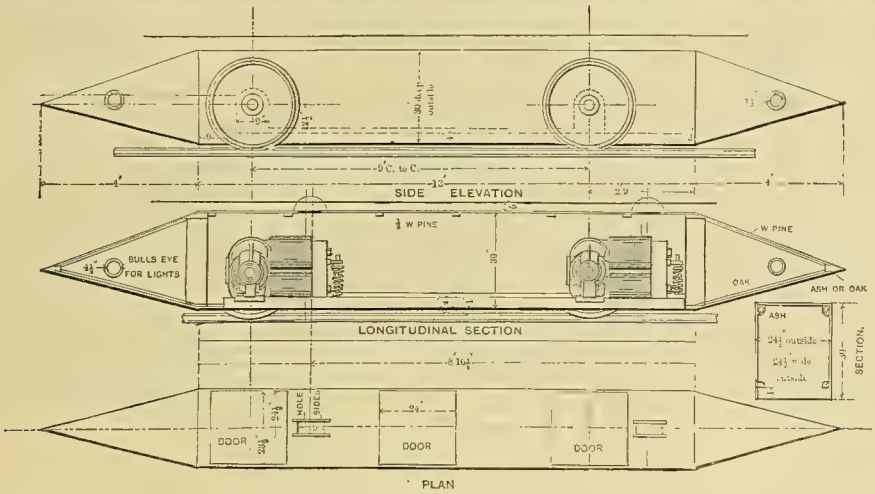

FIG. 1. HIGH SPEED ELECTRIC RAILWAY WORK.

Up to this time the electrical work had received only such engineering attention as could, from time to time, be given by employes of the Sprague company, much occupied in other ways. It became evident to the Baltimore company that any satisfactory accomplishment could be had only through the continuous attention of some one having had electrical experience.

As superintendent of the Sprague company, I had been familiar with the manufacture of the motors, and had moreover visited the plant; hence in October, 1889, it was arranged that further experiments should be under my direction. Throughout the work B. J. Dashiell, Jr., M. E., and H. F. Purdy of the Sprague Electric company were of con tant assistance, both in conception and execution of all that was done.

Work having been resumed it was soon found that a given speed could be attained with less current if two motors were in service than with three, and consequently the motor on the middle axle was removed. It seems probable that, when running, this middle motor was largely occupied in skidding the wheels driven by it, since the two outer axles on a yielding track would doubtless support the greater part of the weight. In any case, the two motors were able to produce a greater speed than the track could stand. These machines were of the U type. The armature was wound with 100 sections of No. 12 B. W. G. wire, each section of two turns. This armature with its commutator was rigidly mounted on the axle. The pole-pieces were attached to brackets centered on the axle, the keeper was spring-supported on cross-piece carried by the steel casing. Bearings were of phosphor-bronze and lubrication by oil from an ordinary cup. No trouble on this score was experienced. Each magnet core was wound with 120 turns of No. 4 B. W. G wire. At 30 amperes the armature induction was about 80,000 lines per square inch. An outline of the motor is shown in Fig. 1. These motors, since wound, according to specification, for the 500-volt circuit were originally connected in multiple arc. This connection was changed, they being placed in series, thus diminishing the potential-control, required at the station, by reason of the fact that the machines were run at a speed so much below that for which they had been calculated.

To supply the current, contact was made between the upper rail and brushes of sheet copper set against the rail by springs. These served their purpose well. The return circuit was through the wheels and rails, the steel casing being insulated from the axle by fiber plates and washers at joints and bolts. Rail bonds, covering joints in upper and lower rails were used throughout, the resistance of the external circuit from the feeder junction to a point diametrically opposite was about 0.25 ohm

The station was placed inside the circle about 200 feet from the track. The generator was a 70 horse power Edison machine, not compounded originally, and was driven by a 90 horse power high speed Ball engine. At first a wire resistance of about 12 ohms was used to lower the potential on the line, as it was not convenient to run the dynamos at less than 400 volts. Later, a whisky barrel was filled with water, an iron plate, 8 inches square was placed in the bottom, a similar plate was fixed to the end of an iron rod, and this rod attached to the pulley permitting easy lifting or dropping of the plate through the water. These plates being connected in the main circuit, a very serviceable liquid rheostat resulted, which, when "taken with a grain of salt," answered excellently the purpose of regulating currents which often went as high as 150 amperes.

The usual course of a run was this. Speed-observers, as many as could be had, up to five or six, were stationed around the circle, distance apart being known. Watches of these observers and of recorders who read current and potential were compared. Potential readings were taken at the station and at one or two points on the line, permitting easy reduction to horse power. Mr. Dashiell, my assistant, then took the engine and I managed the dynamo. A current of from 20 to 40 amperes usually started the car. The size of the armature wires limited to about 90 amperes —45 in each machine—the current permissible for any length of time. This value was usually attained in the first half mile of run, a considerable part of the external resistance having been cut out. When the car had attained a speed of 75 to 100 miles per hour, the line potential was in the neighborhood of 450 volts, the iron plates in the barrel being in contact, having been slowly approached as the counter e. m. f. increased. The time limitation of the runs, was invariably caused by failure of the track to serve its purpose. On three occasions the car left the track; once at 45 miles per hour, once at 80 miles per hour and once, the last time, at about 115 miles per hour. Curiously enough, on the two former occasions the derailment was to the inside of the circle, super-elevation being about four inches.

It was easy to tell in the station when a derailment was imminent, as the ammeter was most violently agitated by the make and break of the circuit caused by the particularly bad spots in the track. The agitation increased with each trip round the the circle, and ended in a run-off, or, after some experience had been gained, in a cessation of the trial. As the track limited the length of run in time, so also it limited the speed obtainable. Each trial—the longest being about twenty-two minutes consecutive running—was followed by an overhauling of the track, requiring from a few hours' to a week's work by four or five men.

Could the experiments have been made on a roadbed and track, deemed even second-class according to steam railway standards of rail weight, etc., there can be no question that without any other change, the car could have maintained for several hours a speed of 120 miles per hour. Indeed, I know of no time limitation that would have arisen save that from a limited oil supply.

The speed obtained in the first round—that is in the first 9,240 feet—varied from 30 to 75 miles per hour; this determined by the management of the rheostat. The *rate* of acceleration from point to point in going round the circle was irregular, due to the grades, which going in the direction usually followed, varied from 20 to 25 per cent.

The fact that the track—always bad—went rapidly from bad to worse during each run, made it difficult to analyze the records with a view to determining the true coefficient of traction. Moreover the coefficient for such a track, even in its best condition, would be greater than for the track that would necessarily be built for actual service.

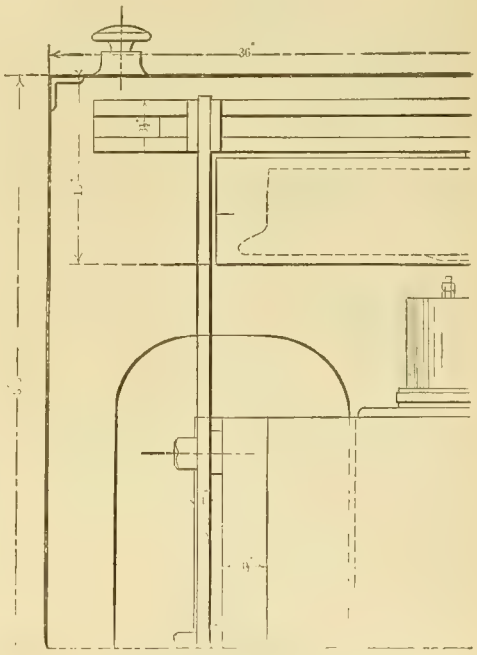

FIG 3. HIGH SPEED ELECTRIC RAILWAY WORK.

The figures obtained were of little worth as far as fixing absolute values at very high speed, but at least served to show the error of many train resistance formulæ found in the text-books. Some of these formulæ give good enough results when used for the low speed on which they are based, but their algebraic form is such as to give rise to great error when higher speeds—say 80 to 120 miles per hour—enter. This whole matter of train resistance has been more fully treated in a paper, "Limitations of Steam and Electricity," read by me before this institute on May 21, 1890. The particular element of atmospheric resistance, for which special experiments were made at Laurel, was fully treated in a paper read by me before the West Point Branch of the Military Service Institute, and publised in London *Engineering*, May 31 to June 13, 1890.

Using for atmospheric resistance, figures resulting from the experiment herein referred to, we may analyze thus:

RUN OF OCTOBER, 1889. FLAT HEADED CAR.

Time of 1st round, 3.8 minutes Av. speed=2430 f. p. m.=28 m. p. h
" " 2d " 2.8 " " =3300 f. p. m.=37.4 m. p. h.
Average rate of work done by motors in 2d round=15.0 h. p. 495,000 ft. lbs
Average horizontal effort in 2d round=495,000÷3,300=150 lbs
" " " " " " for atmospheric resistance=30 lbs.
Average horizontal effort in 2d round for acceleration (approx.)=10 lbs.
Average horizontal effort in 2d round for other resistances=110 lbs.
" " " " " " per ton=110÷2.4=46 lbs.

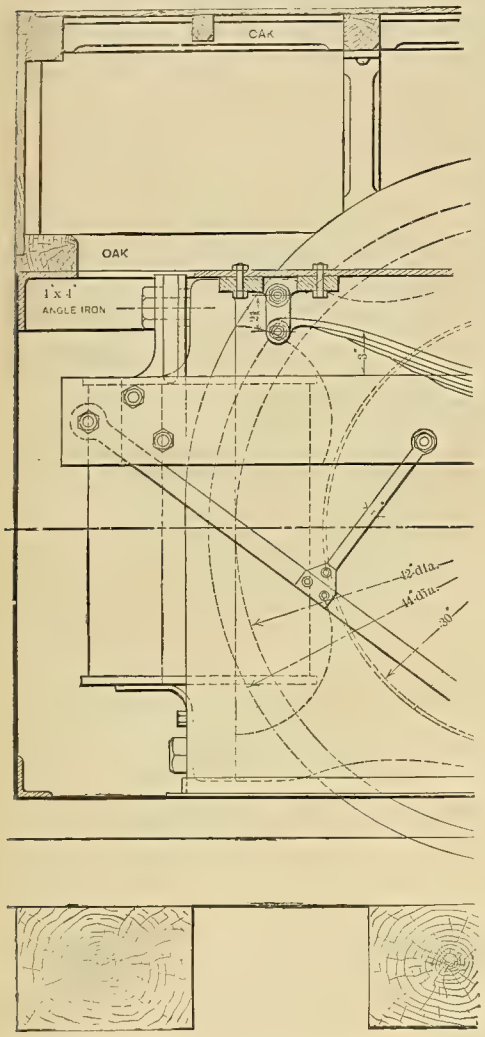

FIG. 4. HIGH SPEED ELECTRIC RAILWAY WORK.

RUN OF NOV. 13, 1889. FLAT HEAD.

Time of 1st round=4.25 minutes. Av. speed=2170 f. p. m.=24.7 m. p. h.
Time of 2d round=2.5 minutes. Av. speed=3700 f. p. m.=42.0 m. p. h.
Time of 3d round 2.5 minutes. Av. speed=3700 f. p. m.=42.0 m. p. h.
Average rate of work from middle of 2d to middle of 3d round=15.5 h. p. =511,500 ft. lbs.
Average horizontal effort=511,500÷3700=138 lbs.
" " " for atmospheric work=36 lbs.
" " " " acceleration=0 lbs.
" " " " other work=102 lbs.
" " " per ton=102÷2.4=42.5 lbs.

RUN OF NOV. 13, 1889. PYRAMIDAL HEADED CAR.

Time of 1st round=4.0 minutes. Av. speed=2410 f. p. m.=26.2 m. p. h.
Time of 2d round=2.0 minutes. Av. speed=4620 f. p. m.=52.4 m. p. h.
Time of 3d round=2.25 minutes. Av. speed=3678 f. p. m.=41.8 m. p. h.
Time of 4th round=2.25 minutes. Av. speed=3678 f. p. m.=41.8 m. p. h.
Time of 5th round=2.25 minutes. Av. speed=3678 f. p. m.=41.8 m. p. h.
Time of 6th round=2.25 minutes. Av. speed=3678 f. p. m.=41.8 m. p. h.
Average rate of work in last four rounds=16.0 h. p. 528,000 ft. lbs.
" horizontal effort=528,000÷3678=144 lbs.
" " " for atmospheric work=24 lbs.
" " " " acceleration=0 lbs.
" " " " other work=120 lbs.
" " " per ton=120÷2.4=50 lbs.

RUN OF DEC. 2, 1889. PYRAMIDAL HEADED CAR.

Time of 1st round=1.8 minutes. Av. speed=2070 f. p. m.=28.5 m. p. h.
Time of 2d round=1.[illegible] minutes. Av. speed=5120 f. p. m.=70.0 m. p. h.
Average rate of work in 2d round 11.0 h. p. 1,353,000 ft. lbs.
" horizontal effort=1,353,000÷[illegible]=[illegible] lbs.
" " " for atmospheric work=38 lbs.
" " " " acceleration=12 " 80
" " " " other work=2[illegible]=80=141 lbs.
" " " " ton=141÷2.4=58.7 lbs.

The highest speed attained in this run was 90 to 95 miles per hour; track was very bad; car derailed.

RUN OF DECEMBER, 1889. WEDGE HEADED CAR.

Speed maintained at 100 miles per hour, with rate of work 44-horse power. Moreover, some work of acceleration was done, but records do not permit accurate determination of this. Omit acceleration, and we have:

Average speed=8,800 f. p. m.=100 m. p. h.
" horizontal effort=44x33,000÷8,800=165 lbs.
" " " for atmospheric work=48 lbs.
" " " " other work=117 lbs.
" " " per ton=117÷2.4=48 lbs.

Highest speed attained this run = 110 to 120 miles per hour. Track better than in last run, but car was derailed at maximum speed.

These values, 46.0, 42.5, 50.0, 58.7 and 48.0 lbs., should be corrected for curvature, making them, 30.7, 28.4, 33.4, 39.1, and 32 lbs. respectively. Other and lower values were obtained when the track, as at first was in better condition. But these earlier runs were not recorded in exact figures. The rails were in all cases rusty.

This rate could not be absolutely determined, since the car left the track at some distance from the last two observers, whose time records gave the speed attained between the points of observation. It was clear, however, that final speed was between 110 and 120 miles per hour. A length of 1000 ft. of track was injured, about 300 ft. of the upper framework wrecked, and the car itself was landed about 30 ft. from the track, having finally jumped the guard rails while going over a fill 4 or 5 ft. high. It seemed clear that the Laurel plant had passed its days of usefulness. Nothing further of value could be done without practical rebuilding. It was then time to make new plans, and this work was at once begun by Mr. Dashiell and myself. At the outset I felt that—if for no other than commercial reasons—we should plan for the carrying of passengers as well as parcels. This meant an increase in the size of cars and a change from an attempt at automatic control to control by human intelligence on the locomotive.

For purposes of demonstration I proposed to the company that they should build a track about four miles, not less, in circumference, and should run thereon a train of two or three cars drawn by one locomotive. Calculations were based on the following data:

1. A speed 150 miles per hour on a level was to be aimed at.

2. Cross-section of car should be a minimum, consistent with the seating of passengers. This was taken at 6 ft. by 5 ft., 30 sq. ft. (crowning higher along middle of car).

3. Gauge of track should be standard—4 feet 8.5 inches.

4. Character of track should be simply the best that art could contrive, rails to be from 65 to 90 lbs.

5. Electro-motive force should be as high as the art of insulation would permit.

6. Whatever might be the number of cars in a train, all were to be so connected as to present a continuous exterior, thus presenting only one cross-section to the atmosphere.

7. Atmospheric resistance at 150 miles per hour would be taken at 15 lbs. per square foot of cross-section, a wedge or parabolic locomotive head being used. This value is 50 per cent in excess of that indicated by our experiments.

8. Traction co-efficient, exclusive of air resistance, would be taken at 150 miles per hour to be 25 lbs. per ton—this for reasons set forth in previous papers.

From the two resistance co-efficients just given, it followed that for every square foot of cross-section, regardless of weight, 6 horse power would be required, and for every ton of weight, regardless of cross section, 10 horse power must be supplied.

For a locomotive of about 600 horse power having 30 ft. cross-section the dead weight was calculated to be about 18 tons. Steel cars of equal cross section were designed, weighing, empty, about 5 tons, with carrying capacity of about 5 tons

The important question as to power required could then be thus tabulated:

	150 M. P. H.	120 M. P. H.
Locomotive alone	360 H. P.	288 H. P.
Locomotive and one car loaded	460 "	369 "
Locomotive and two cars loaded	560 "	449 "
Locomotive and three cars loaded	660 "	528 "

To perform the work here indicated two motors were provided, one armature directly on each of the two axles of the locomotive car. These motors, outlined in Figs. 2, 3, 4 and 5 were of the Manchester type. They were supposed to be at first connected in arc across a 1500-volt circuit, each taking about 130 to 150 amperes and delivering about 250 to 300 horse power. Should it be desired to experiment with higher line potential, the motors in series would permit 3000 volts to be easily tried. The armatures of the gramme type are 30 in. outside, 23 in. inside diameter. The armature conductors were to be of about 40,000 circular mils, cross-section, or from 500 to 600 cm. per ampere. Many successful machines, designed to work indoors, go as low as this figure, and since the dissipation of heat must in such case proceed more slowly than in the case here considered, the figure seemed very safe. Moreover, it was intended to introduce a blast of air from the car front which should continuously flow through the open center of the armature (gramme type). How far the rate of dissipation would be carried by such means cannot now be known, but all recent evidence (see experiments of Mr. Kennelly) goes to show that the heat capacity would be much increased.

The cross section of core in the armature was 3.5"x40" =140 square inches gross, or, deducting 15 per cent for paper insulation between disks and 8 per cent. for conductor slots cut in periphery, 110 square inches net. Through this armature it was desired to force 22,000,000 lines (C. G.

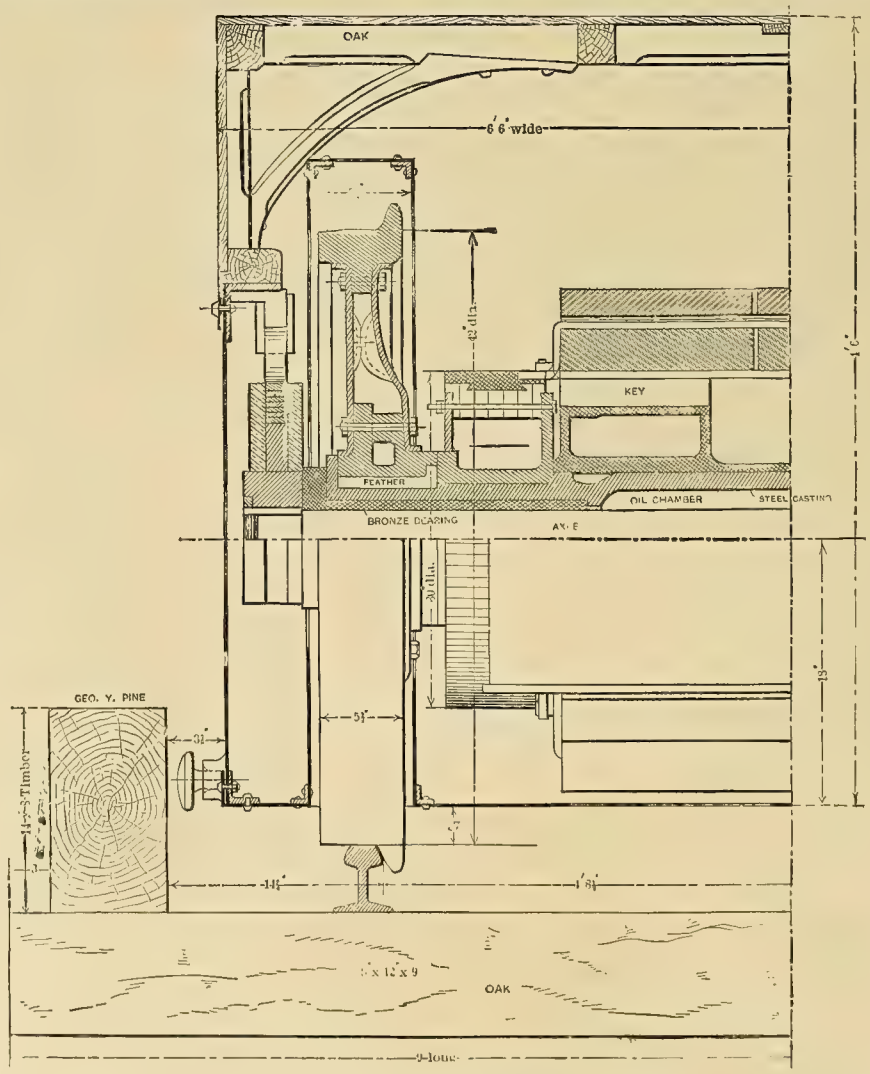

FIG. 5. HIGH SPEED ELECTRIC RAILWAY WORK.

s. units) or 100,000 per square inch = 15,200 per square centimeter.

The hysteresis loss in such an armature revolving at 1200 R. P. M. (equivalent with 42 inch wheel to 150 M. P. H.) was calculated to be about 3,000 watts—following the curve published by Esson. The $C^2 R$. loss ($C = 135$ amperes, $R = 0.26$ ohms when $T = 75$ C) = 4740 watts,—or about 8000 watts for the two losses. I found it difficult to obtain such co-efficient as would give reliable values for loss due to Foucault currents. With very thin plates it would not be large. From what precedes, it followed that the number of armature conductors should be 340. These were divided into 170 sections, wound in one layer, each conductor to lie in a slot; both slot and conductor were planned to be rectangular, or nearly so, with the reservation that experience in manufacturing would soon show the proper detail.

The magnets have a cross-section of 164 square inches through which 14,300,000 lines of force must pass, the increase from the number in the armature being determined by a leakage co-efficient 1.3.

The magnet coils of the two armatures were calculated to be in series with each other, but in shunt with respect to the two armatures. This variation from present street car practice I thought to be justified by the following considerations: First, no system of commutation could obviate the need of a considerable external resistance, which then could be easily made sufficient, within itself, for speed control; second, the maximum torque for a given armature current is always desirable and can be best obtained by permanent saturation; third, this constant and maximum magnetization would tend to diminish sparking—an evil to be specially avoided in long distance work, involving continuous runs of several hours.

While it was thus intended to use shunt coils at first, I felt that a little experience would soon positively demonstrate that the advantage lay with this or the series winding.

The commutator, Fig. 5, was designed to be 23 inches in diameter, which would of course give rise to a very high speed relative to the brushes. I believed it better to face the mechanical trouble that might be connected with great circumferential speed rather than to diminish the diameter by decrease of sections, since this in turn might produce sparking.

Without going into the mechanical detail of the commutator, I may add that a single bar could be taken out or replaced, without removal from the shaft.

The rheostat for the armature circuit was designed to be of iron wire, with the expectation however, of experimenting also with liquid or carbon resistance. The resistance and heat capacity of this main line rheostat were determined with reference, first, to current necessary for starting, second, to currents needed for maintaining low speeds. The starting current on practically level track was calculated to be from 300 to 400 amperes, the load being 80,000 lbs. (or locomotive and three loaded cars.) For continuous running at 30 miles per hour, a current of 40 amperes would be required, the counter e. m. f. of each of the 1500-volt motors being, at this speed, only 320 volts. The line-potential being 3,000 volts, it would be necessary to have in the armature circuit an external resistance of 59.0 ohms $= \frac{3000-640}{40}$. The wires were calculated to stand 40 amperes continuously, and the various sections were proportioned to stand various currents for such time as would serve to bring the train up to speed. It was of course, known that a considerable reduction in the size of resistance box could be effected by winding the motors for the regular line potential, thus normally working them in arc, but putting the armatures in series where a great reduction in speed might be required.

A small rheostat and a condenser were designed to be placed in the circuit of the magnet coils, and a rheostat also in the lamp circuit, these resistances giving delicate control.

The problem of retardation for a mass of say 40 tons running at 150 miles per hour, is a serious one. The Galton and Westinghouse tests indicate a very low value for the coefficient of friction between brake-shoe and wheel, at high speeds; they report it in some cases at 60 miles per hour as low as 0.04. As however it rapidly increases at lower speeds, an average of 0.1 may be taken. The total retarding effort, i. e., brake resistance and track and atmospheric resistance must be kept below that which will just produce sliding of the wheels, and the coefficient of sliding may be taken on an average at 0.08 of the weight of the wheels. If then we represent by P the maximum allowable brake pressure on the wheels, by R resistances other than brake friction, and by W the weight on braked wheels, we may write the following inequality, $0.1\ P + R < 0.08\ W$.

The value of P should be determined as that which, with a small margin will satisfy this condition of inequality.

Following this calculation it was found that a brake-pressure of about 5,000 lbs. should be applied to each wheel. This was designed to be produced by magnetic brakes, similar to those used by Mr. Daft on the New York elevated railway

A mass of 80,000 lbs. moving at 150 miles per hour represents 64,000,000 foot-pounds of energy. Average resistance due to brakes 0.1 x 60,000 6,000 lbs. Average resistance from track and atmosphere for average speed of 75 miles 100 lbs.

In addition, the motors may be required to generate a current which shall be wasted over the rheostat. Since the held circuit in the case of shunt-motors, is independent, magnetization may remain constant, and average e. m. f. of 1500-volt motors (i. e., motors generating 1500 volts e. m. f. at 1100 r. p. m., or, with 42 wheels, at 150 e. m. f.) would be, while the train was coming to rest 750 volts. Make the external resistance such that the two armatures being in series, an average current of 200 amperes shall flow. Then average dynamo resistance, in lbs = 2000. Total retarding effort = 6000 + 400 + 2000 = 8400 lbs. Dividing 64,000,000 by this last quantity we have 7620 ft. as the length of run to come to a stop, and the time of stopping about 100 seconds.

For the mechanical construction of the locomotive, two plans were contemplated. One has a 12 foot rigid wheel base and no pilot wheels; the other has a 7 foot wheel base for the drivers and a pony-axle in front, free to move laterally over a certain distance, dragging the drivers in the same direction. This is the general principle of pilot-wheels, so largely used on high-speed engines. This second arrangement is preferred. In it nearly all the weight goes on the drivers. In this particular case, total weight of locomotive is about 18 tons, each motor being six tons Of the total, 15 tons rest on the drivers. If then the adhesion co-efficient, while running, be taken at only 0.1, a circumferential effort of 3000 lbs. may be exerted without slipping the wheels. This is safe, since if 600 h. p. of work be required at 150 miles per hour, $= 13{,}200$ f. p. m., the horizontal effort $= \frac{600 \times 33{,}000}{13{,}200}$ $= 1500$ lbs. For starting the load, adhesion-co-efficient may be taken at. 25 giving 7500 lbs. possible pull, this being much in excess of the value required.

The locomotive construction is such as to put the entire weight of the armature directly on the axle. In designing this, I did not overlook the fact that the armature must thus be subjected to much jarring. But I believe the difficulty should be met by excellent mechanical construction, rather than that spring movement should in any way be attempted. For mechanism that shall succeed in high speed, long-time service, simplicity is a requirement of the first order. Indeed, generally, in this work connecting an electrical motor to any vehicle, I have long felt that he who is over ingenious in contriving many parts and fine adjustments, may not be over-successful.

The weight of the magnets and pole-pieces goes also directly on the axles, save for the intervention of rubber plates having a maximum play of 1-16 of an inch. By the use of motors of the "U" type, part of the weight might be spring-supported, but on the other hand it is not as easy, with that type as with the Manchester, to obtain a perfectly sparkless motor. Moreover, the weight going dead on the axles in the case considered, is not greatly in excess of that due to 8-foot drivers and other attachments of large steam locomotives. Further, the need of any spring movement decreases with increasing perfection of track-work; as, in ideally perfect track, car-springs would not, save on curves, come into play.

In the first design of locomotive cars, the operator is to sit between the two motors, where also would be placed the controlling devices. In the second design the operator would be placed over the pony-axle, the devices being chiefly in the cylindrical or parabolic head.

Detailed drawings of freight and passenger cars were completed, but need not here be referred to.

As to the supply of current, it is proposed to use the double metallic system. This departure from the ground return now so commonly employed in street railway work seems justified by the following considerations:

1st. For a given voltage it diminishes the cost of insulation, per se.

2d. It diminishes the danger of accident within the motors.

3d. It diminishes danger of accident to workmen.

4th. By being thus more easily handled it is probable that a higher voltage will be found practicable than with the ground return; hence in fact even first cost might not be greater.

As designed, the conductors will be placed in an inverted wooden trough, attached to posts placed at 12 foot intervals on each side of the track. The trough to be about 5.5 feet above the ground. The conductors for each side of the circuit to be two—one insulated and continuous; the other a bare, flat strip, broken into sections, these being normally out of circuit; the locomotive trolley arm operating a switch which shall throw out the rear section and throw into circuit the section ahead. Such a switch was designed in detail.

As to what the line voltage should be, progress in the art of insulation can alone determine. It would, of course, not be necessary, on a roadway for long distance travel, to consider the death producing voltage as a limitation.

In the important matter of limiting curvatures, calculations were made in the ordinary way, using the particular values for weight and height of center of gravity. A safe speed was then tabulated as that which is just one-half the speed that causes the resultant of weight and centrifugal force to pass through the outer rail of a curve. The beneficial effect of super-elevation, neglected in the calculation, would, of couse, practically increase the factor of safety.

The following table resulted from the method described.

Radius in feet.	Safe speed, by rule above, in miles per hour.
1,000	74
2,000	108
3,000	120
4,000	140
5,000	148
6,000	152
7,000	157
8,000	158

Of course, naught save practical trial could determine whether the assumed factor of safety, which is quite large enough at present speeds, would in fact, be right for the higher speeds aimed at.

COMMERCIAL ASPECTS.

Copper calculations were made, based on a station potential of 3,000, and also 6,000 volts, stations being 50

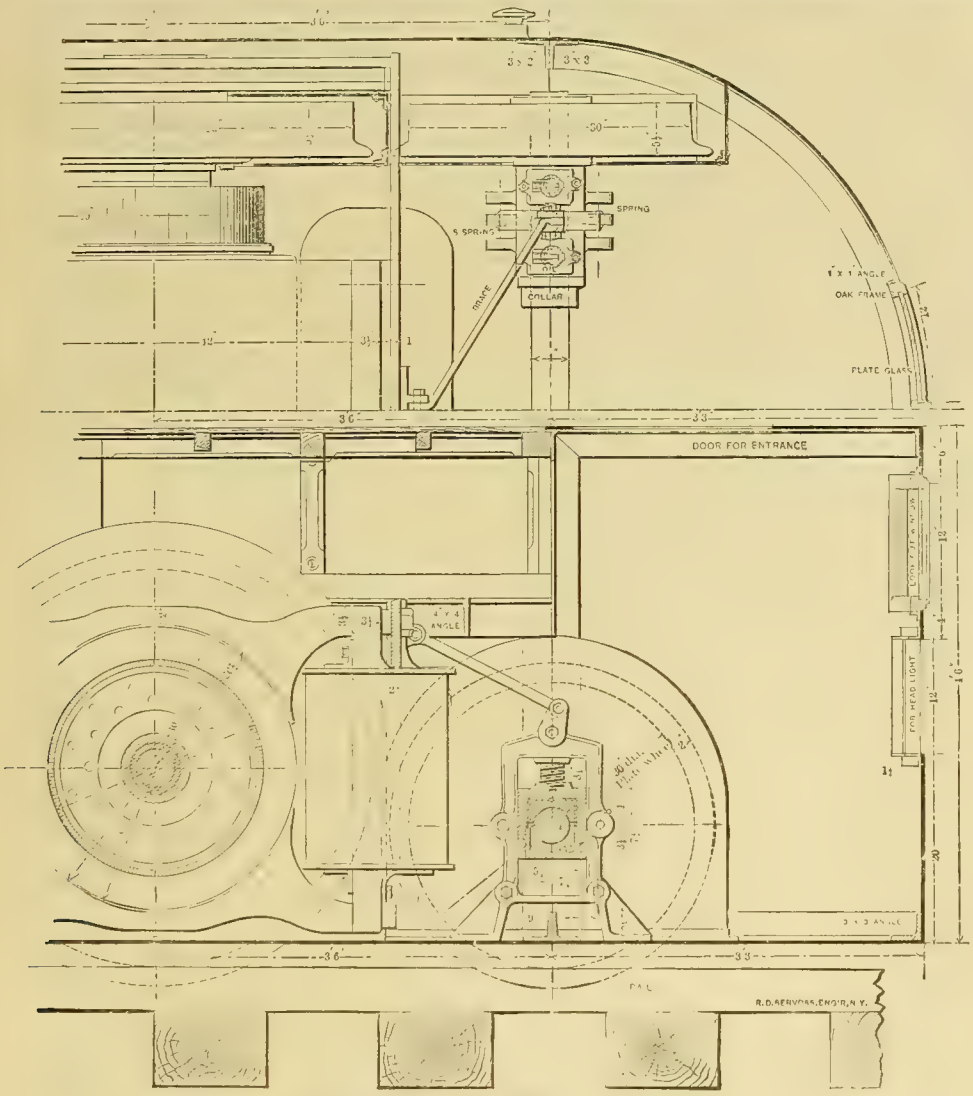

FIG. 6 HIGH SPEED ELECTRIC RAILWAY WORK.

miles apart (thus supplying current 25 miles on each side) and on a service requiring one train on each 25 mile section, the drop on the line being 33% of station potential. Then for a line of 1,000 miles, as from New York to Chicago, with copper at 15 cts. per lb., and for 3,000 volts initial:

Cost of conducting system, including frame work	=	$7,000.00 per mile.
Cost of station per mile, including steam	=	3,000.00 "
" double track, including depots, etc., estimated	=	55,000 00 "
Cost of train equipment, 3 cars each, 50 trains and engines	=	1,000.00 "
Total per mile		$66,000 00

In this the cost of track construction is based on road bed figures reported for the Erie Railway company, To arrive at operating expenses, suppose 20 trains each way each day, and a schedule of 125 miles per hour, *i. e.* 8 hours for the trip. Suppose a station development of 800 horse power per train on the line, or 64,000 horse power hours per trip In stations of large capacity working under the supposed conditions, the cost of one horse power hour = 0.90 cent (see tables in previous paper "Limitations of Steam and Electricity") or per trip, for power a cost of $57.60. For train men, suppose two men on each train, and one per train in reserve, and suppose $3 00 per man per trip of 8 hours, then, cost per train trip = 3 × 3 = $9.00. Interest charge per train trip =

$66,000,000 × 0 05 ÷ 365 × 40 = $225.42

For maintenance of way (see Wellington's Statistics,) take $1,000 per mile of double track per annum, or per day for supposed line $2,700.00 per trip or 2,700 ÷ 40 = $67.50. For general expense of operating company, suppose $1,000.00 per day—or per train trip $25.00. For wear and tear, oil, etc., on train itself, take $10.00 per trip. Then total = $56.60 + 9.00 + 225.42 + 67.50 + 25.00 + 10.00 = $394.42.

For receipts.

Suppose the average train be of two cars (such as designed) having each a capacity of about 10 000 lbs. freight (considered such as express and mail matter), or of say 15 passengers. Suppose the average load of freight, 15,000 lbs., of passengers, 20. Take freight at 33 cents per cwt., passengers at $25 00. The income per trip in either case —$500.00, showing profits, over fixed charges, of say $100 00 per trip, or $4,000.00 per day. The total daily load of freight, each way, required to justify the service above treated is 300,000 lbs., or if 200 through passengers be carried (*i. e.* ten trains for passengers each way each day) then only 150,000 lbs. of freight. The *present* movement between New York and Chicago, in mail and express, is not far from this figure. A five hundred-mile line, connecting Boston, New York, Philadelphia, Baltimore and Washington, would be even more profitable. It is to be remembered also that a service of *small* trains is contemplated, making fixed charges relatively very large. Much larger trains could be, and I think *will be*, run at the speeds here considered, but I have supposed that the smaller effort would precede the larger. It is further to be noted that the use of 6,000 volts potential, and the extension of some existing roadway instead of the building of a new one, would diminish first cost. As grade-crossings would be out of the question, and as cities would require to be entered above or below the surface (country roads to be carried over on bridges) it is perhaps best to consider only the larger figure already used.

To demonstrate all or nearly all that has been outlined in this paper will cost about $300,000, covering the construction and the operation for a reasonable time, of the four-mile circular line proposed above. Last year the Baltimore company met unexpected difficulty in efforts to raise the needed money; their operations were suspended and my connection with them ceased just at the time when plans were completed—even to working drawings. I have been much pleased to learn, within the last few days, that far from being discouraged, they are now confidently hoping that they may push on, in the near future, the great work to which they have laid their hands. Unfamiliar as is the project, you will perhaps be the more ready to share the confidence of its promotors, on hearing the words from Prof. Henry A. Rowland and Dr. Louis Duncan, of Johns-Hopkins, to whom were submitted, last spring, full details of the plans partially described in this paper, after reviewing the figures for power required.

They say: "We believe from the data obtained that the values given are not too low, and that the horse power which Mr. Crosby calculates is *not less than the amount required.* While we have investigated carefully and considered all the data obtainable, yet the existing experiments are not sufficient to accurately fix a limit to the train resistance. *We believe, however, that the value assumed by Mr. Crosby is safe.*"

"The motors, the calculations and drawings for which are in the appended statement, will develop the horse power for which they are designed, namely 500 horse power. We point out some modifications which will be beneficial. *We believe that they will drive the train (locomotive and two cars,* O. T. C.) *at the required speed.*" (Italics here and elsewhere are mine; speed then considered 120 on a level. O. T. C.)

"The possibility of a train being derailed by an obstruction on the track increases with the speed. At speeds up to ninety miles, however, there seems no increase in the number of derailments. In the case in question, the center of gravity of the cars is very low, and *it would be difficult to derail them on straight parts of the track.* The radius of the curves should, of course, be great, but not so great as would be required for an ordinary train going at these high speeds. *The question of safety*, however, *almost wholly a question of track construction.* Considering the form of the proposed train, its comparatively light weight, making a less demand on the track, it is certain that with a carefully constructed road it could attain with safety speeds which would be impossible with trains as at present constructed. As these latter have several times made eighty-six miles, and often made eighty miles, *it would seem that a speed of 120 miles or even more, with the electric cars, would not be outside the limits of safety.*"

"The plan for supply current to the motors is feasible."

"The design of the motors is discussed in the detailed report. It is generally good."

"Should it be demonstrated by an actual test that passenger trains can be run safely and economically at a speed over 100 miles per hour from here to Chicago, the financial aspects of the case would certainly be improved. *We are of the opinion that the chances are in favor of this being accomplished by the present scheme.*"

These words, though guarded and accompanied by criticism of the detail, are yet a substantial approval of what was submitted. To me they were very encouraging.

New York Electrical Society.

Chas. E. Emery lectured before the New York Electrical society at Columbia College on the 6th, on "The Utilization of the Forces of Nature."

Considering first the question of wind, or air in motion, Mr. Emery alluded to the terrific force of the hurricane, and showed a view of the Lake Servias cyclone, which was taken near St. Paul, Minn., and which gave a vivid idea of the irresistible sweep of the wind. The various kinds of windmills were then referred to, and a description was given of the important part played by these mills in the drainage of the low-lying districts of Holland, which have been reclaimed from the sea, and the excellencies of the modern American windmill, which promises to be largely utilized for the generation of electricity, were shown.

The efficiency of several kinds of water wheels was then taken up and followed by some remarks on the turbine, whose action was ingeniously illustrated by a comparison of the movements involved in the rolling of a carpet. In speaking of Pelton wheels reference was made to those used for the production of electrical energy in the Comstock lode, where they operate regularly under a head of 1,680 feet, and where the issuing jet will resist a blow like a bar of iron.

The utilization of Niagara Falls was next discussed, and its stupendous possibilities in the generation of electricity were pointed out. The lecturer took comfort from the fact that the Niagara Falls of picture and song will to all appearances remain the same for many generations, notwithstanding the demands on it which the growing use of electricity may entail, since the comparatively small volume of water required to produce fifty or sixty thousand horse power will hardly be missed by the eye. Under the head of the water power available on streams fed from snow-capped mountains and glaciers, some most interesting facts and figures were given, and the pictures thrown on the screen not only showed the utilization of such forces which are now being made, but indicated the infinite possibilities in this direction which lie in the near future.

Mr. Emery closed his lecture by a description of the several methods used for transporting minerals and other miscellaneous applications of power, with especial reference to the increasing ease and economy with which electricity can be generated through the medium of the forces of nature which modern skill and enterprise are rendering daily more available.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 7.—Two of the biggest electric light companies are seeking to recover $1,000,000 from the city for destruction of their wires and poles during the month of December, 1889. The suit has lately been appealed to the Supreme Court and the claims are based upon the damages done to the business of the companies by Mayor Grant's raid. The United States Illuminating company claims $550,000, and the Brush Illuminating company, $525,000. The papers were served upon Comptroller Myers, who has referred them to the Department of Public Works with a request for full information on the subject, so as to have them turned over to the corporation counsel in his defense of the city against the claims.

The request of the Board of Electrical Control, that the electric light companies name the streets in which they wish subways built, does not seem to have made much of an impression upon the companies. The latest report to the board by Engineer Kearney is that he has received responses from only three out of the seventeen companies which have electric light plants for public lighting. Mayor Grant said that the companies could take the risk of delay if they wished, but it must be clearly understood that all poles and wires must come down on June 1st. Representatives of some of the companies claimed that the time for reporting was not understood, and so the board extended its time until its meeting next Wednesday.

The first five rows of the orchestra of Harrigan's theater were occupied by Thomas A. Edison and 100 of his employes last night. The Edison plant which assists Reilly and the 400 as a rule, seemed to be on a spree for a moment as Mr. Edison entered and took his seat. The lights went out and confusion was imminent, but as the lights immediately began burning again the significant remark of Manager Hanley, "It was singular," left no doubt that it was a practical joke.

The coroner's jury in the inquest into the tunnel collision has found the verdict that the officers and directors of the New York, New Haven & Hartford Railroad company are immediately responsible for the accident and deaths of the employes of the company. Warrants have been issued for the arrest of all and each is held to await the action of the grand jury under bail of $25,000. Chauncey M. Depew, Cornelius Vanderbilt and Wm. Rockerfeller are on the list. Dr. Depew claims that the legislature has kept the New York Central company from extending the openings in the tunnel for ventilation and light. He says that signaling would be impossible if the tunnel were lighted with electricity and had the scheme of lighting the tunnel been carried out, such an accident would have been charged to the electric lights. It has been suggested that powerful arc lights would make a perfect signal light in the darkest tunnel, and the adoption of such lights for signaling has been urged.

The regular meeting of the Electric Club to nominate officers for the year beginning May 1, 1891, will be held at the club house Tuesday evening, March 17, at 8 o'clock.

C. W. Price, formerly connected with the Daft Electric company, has become associated with Z. Latshaw as selling agents for the National Electric company of Eau Claire, Wis. Their offices are at 50 Broadway, New York.

H. A. Cleverly of Philadelphia is presenting his numerous friends a handsome thermometer, an acceptable gift and at the same time a reminder of superior workmanship from his factory.

A series of robberies of the wires of the New York & New Jersey Telephone company is reported from New Jersey. A gang of daring thieves climb the poles, cut the wires and carry the latter off.

Sixteen sections of wire between Elizabeth and Linden Park were stolen in one day, while at the same hour the following day the wires leading to the Singer Machine Works were stripped from all the poles along Trumbull street, Elizabeth. Friday night Manager Root was startled at discovering that the wires leading from Elizabeth to Westfield had been severed and some of the wires carried off. A force of special officers has started out to hunt for the robbers, who evidently are expert linemen. The stolen wire sells for 25 cents a pound. W. H. T.

Minneapolis, Minn.

MINNEAPOLIS, Minn., March 5.—The Edison Light & Power company is so closely identified with the ownership of the great Lumber Exchange building that the recent fire may almost be said to have been its misfortune. When the Lumber Exchange was first built it presented a frontage of 100 feet on Fifth street, and 40 feet on Hennepin avenue. Its owners, however, owned a quarter of a block of real estate adjoining the structure fronting on Hennepin avenue, and in 1889 a new company was organized to erect the great 12-story Edison Light & Power building on the rear of this property. Later, plans were prepared for the continuation of the Fifth street building, about 100 feet down Hennepin avenue, to connect the Edison Light & Power building and the Lumber Exchange. These plans had been so nearly carried out that the stone and iron work on the new building was completed, and nothing remained to be done but to place the interior woodwork, when the fire of Thursday morning swept through the Fifth street structure, and a part of the new Hennepin avenue building. The Edison structure proper only escaped destruction by its admirable fireproof character. The intense heat cracked every window on the west side, and the sash was burned out of one window on the twelfth floor. This was the only damage done to the Edison structure, though its owners are compelled to stand a loss on the Lumber Exchange building, aggregating $75,000. In the burned building the Edison Light & Power company had its general offices, but its valuable office property was protected from injury by vaults. On the ground floor Leonard & Izard and A. T. Huey, electricians, had offices. Their office furniture was destroyed. The fire resulted in some damage to the telephone and electric lighting companies by the destruction of wires, and stopped the street car service for eleven hours on several lines.

The Minneapolis Street Railway company has another petition for the construction of an electric line on its hands. This time the project is to connect the stockyards on the east side with the city by means of an extension of some suburban line. As in the case of other similar propositions the company replies that it is willing to co operate with the citizens interested, but cannot at present undertake the project. At a meeting of the petitioners recently held a committee was selected to secure the opening of a street, which might be used as a route. Another committee, consisting of Messrs. Moore, Thiere and Thwing, will ascertain the cost of building such a line.

The St. Paul Street Railway company has divided the direction of its electric and cable lines, and placed the

former in control of A. P. Wilkes. General Manager Scott says that this movement was made necessary by the great increase in travel, and the necessity of maintaining a time card on all lines. To-day electrical service was applied for the first time on the Rondo street line. The increase of travel on the West Seventh street and Hamline extensions has made it necessary to lay double tracks, and this will be done as soon as the frost is out of the ground.

A $15,000 damage suit has been commenced against the Erie Telephone company by August Johnson. This action is the result of a runaway by which Johnson lost the sight of one eye, and injured the other. He claims it was caused by a telephone pole which overhung the street.

Senator McMillan has succeeded in getting his street franchise bill passed by the Minnesota state senate. It provides that all franchises for the use of streets must be sold to the highest bidder, and that no franchise shall be granted for a longer period than twenty years. The bill reducing street car fares is still in *statu quo*.

The Stillwater, Minn., Electric Railway company is having trouble with the city council of that place. At a recent meeting of that body a resolution was adopted authorizing and instructing the city attorney to bring legal action against the company to enforce the performance of its contract under the city ordinances granting the franchise. The purpose of this movement is to secure better motors, and more of them. Dr. Allen, president of the company, is preparing a written statement in which he will assert that the company which contracted to furnish the electrical appliances, supplied a poor and insufficient equipment, and that several 40-horse power motors are being constructed for the new cars, which will be put in operation about May 1. The company operates, in addition to the Stillwater system, a line four miles long, running into South Stillwater.

The Minnesota Electric Gas & Mantel factory of Minneapolis has been incorporated. Its capital stock is $25,000. N. O. F.

Indianapolis, Ind.

INDIANAPOLIS, Ind., March 5.—One item in the appropriation bills before the Indiana legislature calls for $40,000 for an electric lighting plant for the central hospital for the insane. In the last report of the board of trustees of that institution the following statement and recommendation is made: "The annual cost of illuminating gas for the hospital is $5,000 As a matter of convenience, safety and economy an electric light plant should be provided of sufficient capacity to supply the demand for all the buildings and grounds; and we urgently recommend an appropriation for this purpose. An estimate of the cost of such a plant will be hereafter submitted."

What was known as the suburban rapid transit bill passed both houses of the legislature. Since its passage Dr. Light of Broad Ripple, who is interested in the electric line to that place, says it will now be pushed to completion, and that cars will be running to that resort this summer.

A company has been organized to build a street railway line to Greenwood, nine miles south of this city; capital stock $150,000.

When bids were asked for city lighting four electric lighting companies responded. The light committee favors buying machinery to install a plant for the city, but as the city has no money to buy a plant and no way to raise the necessary amount the matter has been dropped for the present. Under the new city charter recently passed by both branches of the legislature a board of public works will have to wrestle with the lighting question, and its decision must be approved by the city council. M.

Kansas City, Mo.

KANSAS CITY, Mo., March 7.—The Missouri & Kansas Telephone company is engaged in a survey of the lower part of the city, so as to enable the company to perfect arrangements for putting its wires underground. The survey consists of establishing a record of the gas and water mains, and all manner of street improvements. When this preliminary work is finished the company will ask the council to grant it a franchise for putting the wires underground. As far as possible the company desires to lay its conduits in alleys, as the expense of tearing up the paving and replacing it is much less than would be the case were the conduits laid in the streets. The company has not yet determined upon the location for its new office.

The Thayer-Enright Electric Street Railway company's franchise was brought up in the last meeting of the Kansas City council, and granted after a few changes were made. The company is given three months in which to accept the franchise, and one year thereafter in which to complete the line. The privilege of operating the line during a period of twenty years was allowed.

The date of the trial trip of the new Consolidated Cities & Chelsea Park road, known as the Armourdale Electric line, has not been definitely set, but everything, it is stated, will be ready for a start Feb. 28.

The engines and dynamos at the Bluff street power house were tested a week ago, and worked satisfactorily. The cars and motors have arrived, and a switch from the "L" road to the electric line has been tried at the Riverview station.

G. C. Kinsman, superintendent of telegraph on the Wabash system, who was in the city this week, left last night for Chicago. Mr. Kinsman stated that there would be considerable construction work done on the Kansas City division this year. Another wire will be strung from Kansas City to St. Louis, making three wires between the two cities, and thus increasing telegraph facilities between Kansas City, Chicago, Detroit and Toledo. New wires will be strung out of Norborne and Brunswick, and the lines all over the division will be increased.

The lower house of the state legislature has passed the bill providing for the taxing of bridge, telegraph and express franchises. Section 7,755 of the bill provides that the franchises owned by telegraph companies shall be subject to taxation for state, county, municipal and other local purposes, to the same extent as the property of private persons. P.

Omaha, Neb.

OMAHA, Neb., March 5.—To grant or not to grant another franchise to another electric light company is a question over which the city is now pondering. The applicant for favor is the Ballou Electric Light company of Plattsmouth. In compliance with instructions from the council, the city attorney prepared an ordinance granting the franchise sought by the company. This ordinance was radically amended by the chairman of the judiciary committee before presentation to the council. The city attorney called attention to this and enumerated the changes as follows: "The ordinance just read differs with my draft in three radical respects. The original ordinance limited the franchise to the Ballou company. The ordinance just read grants to that company and its assigns, thus making the franchise transferable. The original ordinance that I prepared contained a clause granting that the city, at any time, shall have the right to purchase the property in question upon an appraised value. This provision is stricken out of the new ordinance. The original contained a provision against consolidating the stock, franchise or earnings with any other electric light company. The present ordinance simply prohibits consolidation of its stock or earnings with any other electric light company operating in the city of Omaha at the time of the passage of this ordinance. The power to amend, alter and reject is stricken out of the ordinance. These changes are radical, and against my judgment."

The chairman of the committee acknowledged that he had made the changes, and gave as his reasons that the ordinance was so closely drawn that the company coul not furnish the cheap light desired. If the council made it conform to the ideas of the city attorney, he said, the company could not possibly accept the franchise.

Mr. Wilie, of the New Omaha Thomson-Houston company, said: "The ordinance drafted by the city solicitor was all right. I do not consider this Ballou company a competitor. The idea of a company doing business in Omaha and expecting to expend only $50,000 in a system and plant is ridiculous. At the present time our company has a paid-up capital of $600,000. This is all invested in our Omaha system and $100,000 additional, so you see $50,000 would not go very far in lighting streets, stores and buildings."

The fight over the granting of the franchise is rapidly becoming one of the most determined and bitter ever known in a similar connection in Omaha. C. H. C.

Pittsburgh, Pa.

PITTSBURGH, Pa., March 5.—The Postal & Western Union Telegraph companies' wires, the electric light wires and the wires of the street car companies, were temporarily disabled last Tuesday, on account of the snowstorm which swept over this part of the country.

The injunction asked for by the Pennsylvania Railroad company to restrain the Uniontown Electric street railway company from running cars across its tracks was refused by Judge Ingraham a few days ago.

The Allegheny councils have at last passed an ordinance providing for the payment of the city's electric lighting plant by ordering the issuance of $100,000 electric light bonds.

Pittsburg has been visited by a flood, and the waters of the Monongahela, the Ohio and Allegheny have covered the lower parts of the twin cities to such an extent that the residents in these portions were obliged to live in the upper stories of their houses for several days. All the manufacturing places, mills, iron works, etc., were obliged to shut down for a considerable period, and it has been estimated that about 25,000 people will be out of work during this time. The electric street car companies were also made to suffer greatly by the flood. All the streets in the lower portion of the city were covered with water several feet deep, and for two days traffic on the electric street car lines had to be stopped.

The Postal Telegraph company is having trouble with the construction of its new line from New York to Chicago. The land owners at Warren, O., are opposing the construction of the line in that city and an action for a right-of-way is pending against three Trumbull county farmers. The company finds that the point at issue has never been passed upon by the Ohio Supreme Court, and it will be taken there eventually for the purpose of establishing a precedent. Of course, while the litigation is proceeding, work on the lines has been stopped. E. H. H.

Cincinnati, O.

CINCINNATI, March 5.—The First Cincinnati Edison Illuminating company, which commenced operations September 4, 1886, in the basement of the Western Union Telegraph building, has moved its entire plant to more commodious quarters on Elm street. This plant is located in the very heart of the city, and as the company was the first to engage commercially in incandescent lighting it has enjoyed prosperity from the start. The station commenced operations equipped with two 100-horse power Abendroth & Root water tube boilers, two 80-horse power Armington & Sims automatic cut-off engines and four 400-light 110-volt Edison dynamos, having a capacity of 1,600 16 candle-power lamps. In January, 1887, one 150-horse power New York Safety engine and two 800 light 110-volt Edison dynamos were added. The station was forced to its utmost capacity, but the demand continued, and the selection of a new location was required. The present outfit consists of two 150-horse power upright tubular boilers, one Laidlaw & Dunn Duplex boiler feeder, one 150-horse power New York Safety engine, one 100-horse power and one 80-horse power Armington & Sims automatic cut-off engine, driving direct two 800-light, two 600-light and two 400-light Edison dynamos, giving an actual capacity of 3,600 lights. They are furnishing about 5,000 lights. F. E. Pennel is the engineer in charge.

F. E. Perry, formerly with the United Edison Manufacturing company, S. I. Crane, engineer of the First Cincinnati Edison Illuminating company, and G. T. Kuntz have engaged in general electric repair and construction business, and have opened extensive shops and offices in the Nevada building, this city. They are capable and practical men, having been associated in the electric light and motor business for several years. They have secured the agency for the C. & C. Motor company of New York and have already installed a lighting plant in the St. Nicholas Hotel of this city. It consists of three C. & C. dynamos with a total capacity of 1,000 16 candle power incandescent lights.

A fire in the engine room of the Main street electric Railway station at Mt. Auburn Monday last was discovered in time by employes to extinguish before serious damage was caused. W.

Cornell University Notes.

ITHACA, N.Y., Feb. 26.—A number of interesting lectures have been delivered before the Cornell Electrical association recently. Prof. E. L. Nichols occupied an hour pleasantly in speaking of his "Experiences in Edison's Laboratory at Menlo Park." The failures and successes attendant upon the development of the incandescent electric light were plainly set forth by the speaker. "Characteristic of the man Edison," said Prof. Nichols, "was the fact that at the very time when incandescent lamps were costing $5 to manufacture he avowed that he could, and actually entered into a contract to, furnish them at 25 cents each." At the meeting following Prof. Thurston spoke in his usually interesting manner upon "High Speed Engines for Electric Lighting Purposes." His lecture was fully illustrated by lantern slides. Professors Moler and Ryan also each occupied an hour before the association, the former discussing "The Charging and Regulation of Storage Batteries," and the latter speaking upon the subject of "Drum Armature Winding." The lectures for the next few weeks will be by non-resident speakers. The interest in these meetings has been greatly augmented by this course of lectures.

A corps of students has been repairing the Daft motor cars of the Ithaca street railway.

Prof. Ryan requires this term of every senior, as a part

of the regular work, the design of a complete electric lighting plant for some town or city, the data to be based upon the requirements of the case. The location of the station has to be made by consulting the city map, commercial considerations, etc., being taken into account. The design is to contain complete plans and specifications, and estimates of cost of installation, also estimates and designs of inside wiring for certain specified buildings.

During the past week tests have been made of various power plants throughout the city by members of the senior class.

H. C. Spaulding of the Thomson-Van Depoele Electric Mining company will speak before the Electrical association on Feb. 27th.

G. D. Hulett, '89, is at Sodus, N. Y., engaged in electric railway work.

C. A. McAllister, '87, is located at Washington, D. C., in the Navy Department Bureau of Engineering.

Calvin Humphrey, R. G., has severed his connection with the Westinghouse people, and has accepted the position of superintendent of the Englewood electric light plant.

The following was related by Prof. Edward L. Nichols: "We were taking a yachting trip down the coast and had taken on board something which I suppose a yachtsman ought never to use—an umbrella; however, we thought we we might have to go ashore occasionally and had provided against contingences. The umbrella was stowed away aft near the binnacle, and no more thought of it. While crossing from Cape Ann to Isle of Shoals, a prominent mountain began to loom up some seven or eight points from where it should have been by our compass. This pointed to one of two conclusions—either that the mountain had moved, or that something was wrong with our compass. Discarding the former theory, we proceeded to investigate the compass. All metallic articles were dragged from its vicinity without affecting it until some one thought of the umbrella. When this was dragged from its hiding place the compass immediately swung around and restored the mountain to its true position. The metallic ribs of the umbrella had become, by the pounding of the waves, quite strongly magnetic, and the top of the umbrella, which was within ten feet of the binnacle, was a powerful south-pointing magnetic pole."

P.

Louisville, Ky.

LOUISVILLE, Ky., March 5.—The electric cars on the Fourth street line started running February 24th; about six lines are to be operated by electricity within the next two months. Everybody votes the new line a grand success. The advantage of rapid transit is evident for the number of passengers is now nearly double that under the old system. The Eastern power house is rapidly being completed. Nine motor cars and as many trailers are used. The trailers were made by the Brownell Car company of St. Louis. Cars run from 5:10 A. M., to 12 P. M., at intervals of five minures. The Market and Eighteenth street and the Market and Shelby street lines will be next to be transformed into electric lines and the change will be made in about a month. Electric Light Inspector Smith called upon the city attorney this week, and had a talk about wires and poles. Mr. Smith thinks that something should be done and an ordinance will probably be drawn up to regulate the putting up of poles and wires by the various electric light, street car, telephone and telegraph companies. The Gas company is expected to turn on the electric light contracted for by the city by July. Poles are already being placed for the stringing of wires, where necessary, and the work of erecting towers will begin at once. The linemen of all the electric plants in the city held a meeting last week and organized a Trades Union.

J. W. L.

Detroit, Mich.

DETROIT, Mich., March 5.—The Gamewell Auxiliary Fire Alarm system has been applied to the Russell House in this city.

At the Michigan club banquet recently lights were scattered among the floral decorations with striking effect. The east wall had for a center piece an American shield, eighteen feet high, the stars of which were electric lights. The Michigan shield seven feet high occupied the west wall, and above it a great star with thirty-five electric lights. The great arches of the rink bore 150 electric lights, and on each side of the building were strings of electric lights. Each of the three chandeliers had thirty electric lights.

A much needed improvement has been made in the public library reading-room, by substituting electricity for gas for lighting purposes, the smoke from the latter having darkened the walls and ceiling of the room out of all semblance of their former whiteness.

The Brush Electric Light company of Detroit and the Brush Electric Light company of Cleveland have brought suit in the United States Circuit court against the Detroit Electric Light & Power company, which has the contract for lighting the city, to restrain the latter from further use of double carbon arc lamps.

Citizens of Lawton, Mich., are desirious of running a cable to that place from Paw Paw to illuminate their town by electric light.

Marine City has awarded a contract for lighting its streets by eighty-seven incandescent lamps. The city building will also be lighted by electricity. O.

ELECTRICAL INCORPORATIONS.

The Ohio Water & Light company, Fernbank, O.; capital stock $5,000; supplying villages, towns and cities with water, gas and electricity, etc.

The People's Electric company, Cleveland, O.; capital stock $10,000; manufacturing, furnishing and selling electricity in the city of Cleveland, O.

Bergen & Bayonne Electric company, Jersey City, N. J.; capital stock, $100,000; to furnish and manufacture electricity for heat, light and power.

Indiana Electric company, Indiana, Pa.; capital stock $30,000; supplying light, heat and power by electricity to the public in the borough of Indiana.

The United States Trading company, Chicago, Ill.; capital stock $100,000; dealing in and manufacturing railway and electrical appliances and supplies.

The Lorian County Light & Power company, Elyria, O. capital stock $50,000; supplying Lorian county, O., electricity for lighting and power purposes.

Maine Electrical Improvement company, Brunswick, Me.; capital stock, $9,900; to manufacture and deal in electrical appliances, apparatus and implements.

The Washburn Machine company, Mt. Vernon, N. Y.; capital stock $100,000; to manufacture special machinery tools, scientific instruments and electrical machines.

Waring Sewer Pipe company, Jersey City, N. J.; capital stock, $40,000; manufacturing and selling sewer and drain pipes, artificial stone, electrical conduits and any and all machines.

The Denver Highlands Electric company, town of Highlands, Colo.; capital stock $500,000; furnishing electricity for light, power, heat, etc., in the town of Highlands and elsewhere.

The Akron Electrical Manfacturing company, Akron, O.; capital stock, $100 000; to manufacture, buy, sell and deal in all kinds of electrical apparatus, appliances, tools, machinery, etc.

The Adams Milling & Manufacturing company, Laurel, Del.; capital stock, $80,000; general milling business and manufacturing and supplying electricity and lights to the town of Laurel.

Quincy Electric Light & Power company, Quincy, Ills.; capital stock $5,000; to furnish electric light, heat and motive power by means of electricity, and to make, buy and sell electrical supplies and appliances.

The Davy Electric Suspension company, Chicago; to build and operate a system of suspended carriages for the transportation of freight and passengers under the J. W. Davy letters patent; capital stock, $10,000 000; incorporators, George W. Cole, J. W. Davy, W. W. Shrader and L. A. Bryan.

Providence Telephone company of Mass., Boston Mass; capital stock $10,000; to construct, acquire by purchase, lease or otherwise, own and operate telephones, telephone exchange, telephone and telegraph lines and offices, and all rights, franchises, patents, machinery and apparatus pertaining thereto, and generally to transmit and receive signals by electrity for all purposes and to do a telephone, telegraph and district telegraph business.

THE ELECTRIC LIGHT.

An electric light plant will probably be erected at Cleburne, Texas.

It is stated that the Newport, N. C., electric light plant will be enlarged.

A stock company will operate an electric light plant at Colorado, Texas.

The Jellico, Tenn., Ice & Electric Light company has been incorporated.

Shelbyville, Tenn., is seeking legislative authority to erect an electric light plant.

An electric light plant will probably be put in operation by the city of Augusta, Ga.

The Spokane & Finney Suburb Railway company will construct an electric railroad.

A stock company has been organized to furnish electric lighting at Waynesboro, Md.

R. L. Bloomfield of Athens, Ga,, contemplates the erection of an electric light plant.

A plant is being put up by the recently incorporated electric light company of Woodberry, Md.

At the last meeting of the city council of Parsons, Kas., a contract for electric lights was made with the Parsons Light & Heat company for five years. The number of lamps was increased to thirty-five.

At Troy, Ala., the city authorities have entered into contract for the erection of an electric light plant.

J. A Landry & Co., contemplate the erection of an electric lighting establishment at Lake Charles, La.

The Arkadelphia Water and Light company, of Arkadelphia, Ark., will establish an electric light plant.

The Waco, Tex., Electric Railway & Light company will utilize the water from artesian wells for power.

A. P. Landers of Sulphur Springs, Texas, is commencing the erection of an electric light plant in that place.

The La Grange, Ky., Electric Light & Power company has been incorporated, with a capital stock of $15,000.

The Edison Illuminating company of Boston has increased its capital stock from $1,300,000 to $2,000,000.

A stock company has been formed in Martinsville, Ind., for the purpose of establishing an electric light and power plant.

The city council of Richmond, Va., passed a resolution appropriating $75,000 for the erection of an electric light plant.

It is reported that the Capitol Electric company of Nashville, Tenn., will add a 1,000-horse power engine to its plant.

The city of Attalla, Ala., is about to issue bonds to the amount of $50,000 for an electric light plant and other public works.

A bill has been introduced into the Alabama legislature authorizing the city of Columbia to issue bonds for electric lighting.

The city council of Catlettsburg, Ky., has let the contract for lighting the city for ten years to the Carpenter Electric Light company.

The people of San Jose, Cal., are reported as dissatisfied with the present system of pole lighting, and a return to the tower system is proposed.

The Citizens' Electric Light & Power company of Houston, Tex., contemplates the installation of a 500-horse power engine and four boilers.

The city council of Pulaski, Tenn., has appointed a special committee to consider the question of installing an electric light plant for city purposes.

The Del Rio Texas Electric Light company has awarded a contract to the Westinghouse Electric company of Pittsburg, Pa., for the erection of an electric light plant.

The city council of Parkersburg, W. Va., will receive bids on February 23 for lighting the city with not less than 70 nor more than 100 arc lights of 2,000 candle-power.

The Charleston Gas Light company and the Kanawha Electric Light company, of Charleston, W. Va., have consolidated and will put an additional dynamo in the electric light plant.

It is stated that the Edison General Electric Light company contemplates the erection of an electric light plant in Baltimore to supply private residences. The wires are to be laid underground.

The Clifton Forge, Va., Electric Light and Power company has been incorporated with G. K. Anderson as president; J. E. Frazier, vice-president, and J. G. Woodward, secretary. It proposes to erect an electric light plant.

The city council of Fort Dodge, Ia., has decided to submit to the people of Fort Dodge, at the coming city election, the question whether the city shall purchase and operate an electric light plant of its own. The city is at present renting its street lighting from the Thomson-Houston company.

At Jamestown, N. Y., the common council has entered into contract with the Fort Wayne Electrical company of Fort Wayne, Ind., and the Phoenix Iron Works of Meadville, Pa., to equip and install an electric lighting plant for the sum of $25,250. The capacity of the plant is stated to be 175 arc lights.

The Brush Electric Light company and the United States Illuminating company have begun proceedings in the Supreme Court of New York state to recover judgments amounting to $875,000 against the city of New York for damages done to their business by the removal of poles and wires by order of Mayor Grant in 1889.

The Concord Electric Light company has purchased its steam power plant, consisting of two boilers, and a Reynolds-Corliss engine. The Sydney Smith boiler setting, with Spencer damper regulator, will be used. A Blake feed pump, with a 300-horse power Jacob's heater, will complete the plant. The company expects to start the new station in a few months.

Recent incorporations of electric light companies on the Pacific slope have been as follows: Monterey, Cal, Electric Light & Development company, capital stock, $250,000; Commercial Electric Light & Power company, Tacoma, Wash., capital stock, $250,000; Spokane, Wash., University Heights Street Railway company, capital stock, $100,000; Hillsboro, Ore., Electric Light, Water & Power company, capital stock, $10,000.

At a meeting of the general council, Lexington, Ky., a resolution was adopted, recommending that the city make a contract with the Central Electric Light company, for 5 years, for 200 20 candle power incandescent electric lamps, at $20 per annum, and as many more as the city may desire at the same price, to be lit and kept lighted according to the moon schedule as set out in the contract between the gas company and city of Lexington.

THE ELECTRIC MOTOR.

An electric railway is proposed at Bryan, Tex.

Electric cars have been put in operation in Auburn, N. Y.

An electric railway between Clinton and Lancaster, Mass., is proposed.

R. B. Gout has secured a franchise to build an electric railway in Vernon, Texas.

The Bridgeton, N. J., Electric Street Railway company has been incorporated.

The new Rapid Transit company, of Dunkirk, N. Y., will probably use electric power.

The Union Electric Manufacturing company of Bridgeport, Conn , has been incorporated.

The Street Railway company at Spokane Falls, Wash , proposes to adopt the electric system.

The Altoona, Pa , City Passenger Railway company proposes to change from animal to electric power this spring.

The city railway of Galveston, Tex., which has been equipped with the Rae system, has been formally opened.

The West Street and North End Electric Motor company is operating freight cars between Seattle and Ballard, Wash.

The East End Railway company of Memphis, Tenn., is contemplating the adoption of electricity as a motive power.

It is stated that the Athens Railway company of Athens, Ga , has let the contract for the erection of an electric power plant.

The Edison General Electric company of New York City has the contract for building the new electric railway at Savannah, Ga.

The Capital Street Railway company of Little Rock, Ark., will soon award the contract for the erection of its electric power plant.

A new electric line, four and one-half miles in length, has been put in operation in Flushing, N. Y. The Westinghouse system is employed.

It is reported that all thestreet railways in Grand Rapids, Mich., have been bought by a syndicate, which will change some 36 miles into electric lines.

At Roanoke, Va., electric power will probably be substituted for horses during the year. It is said that the Westinghouse system will be used.

The electric railway extending from Anacortes, Wash., to Hidalgo City, is now nearly completed, It is eleven miles long and cost over $250,000.

The Charlottesville and University Street Railway company of Charlottesville, Va., intends to adopt electricity as motive power and to extend its road.

The National Electric Car company of Washington, D C., has been incorporated, with a capital of $250,000, to erect an electric light and power plant.

The Detroit *Free Press* states that W. C. Turner, of Detroit, has bought the Windsor & Sandwich Street railsystem way and will introduce electricity.

The Columbia S. C., Electric Street and Suburban rail way company will, it is stated, purchase the Columbia Street railway and convert it into an electric system.

The Chattahoochee Land company of Atlanta, Ga , will, it is reported, build an electric railroad from its new town on the Chattahoochee river to Atlanta, a distance of four miles.

L. Williams, of Chimney Rock, N. C., and Frank Reynolds have applied for a charter to build an electric railway from Asheville to Rutherfordton via Chimney Rock.

The Tacoma Railway and Motor company of Tacoma, Wash., has floated $400,000 worth of its bonds and is using this extra capital in the improvement and extension of its lines.

The city council of Knoxville, Tenn., has received a petition for right of way for a new electric line, the Knoxville & Cherokee Street railway. H. H. Taylor has filed a similar petition for a new line on Beaumont stre t in that city.

The Schuylkill electric railway of Pottsville, Pa., intends to build a combined power station and car house, to contain four 80,000 watt generators and two 150 horse power Ball engines. As soon as the weather permits the road will be be extended 15 miles, to Palo Alto, Port Carbon and Tumbling Run.

The contract for power station and entire electric equipment for the electric railway to be built by the Charlotte Consolidated Construction company has been awarded to the Edison General Electric company of New York City, and for construction and track equipment to the Johnson company. The road is to be in operation May 1st.

The car of the "Columbia Snow Sweeper," which was illustrated and described in the WESTERN ELECTRICIAN of Feb. 7th, was designed by George Larkin, chief engineer of the St. Paul City Railway company, and James Tompkins, master mechanic. The motors were designed and constructed by the Columbia Electric company of St. Paul.

The new electric railway at Winnipeg, Manitoba, has been put in operation and is said to be the first electric railway in which all the car equipments were made in Canada. The cars are sixteen feet in length, made by Patterson & Corbin of St Catherine, and the motors are from the Canadian Edison factory, and are of the regular Edison pattern.

Concord, N. H., is to have another electric street railway—the West End—a company having just been incorporated with good financial backing. The road will probably be a belt line running from the railroad stations through the western part of the city. This company will not compete with the old one as the line runs through a section which is not now provided with road.

The Metropolitan railway company, of Washington, D. C., which proposes to use storage batteries, has contracted for three non-condensing compound engines, to be made at the Wright engine works of Newburgh, N. Y. The Campbell & Zell company of Baltimore will furnish three 200 horse power boilers. The entire plant will occupy a plot of ground 122 by 240 feet. C. O. Mailloux is the engineer in charge.

In the new power house of the West End street railway company of Boston, there will be two batteries of boilers, each of 1,000 horse power. In connection with them four engines, each of 300 horse power, and thirteen generators are being put on the opposite side of the building. Twelve of these generators are of 80 horse power each, while the thirteenth one will be of 250 horse power. Eighteen additional generators of 450 horse power each are said to have been ordered.

The Joplin, Mo., Electric Street Railway company will extend its line to Blendeville, one and one-half miles southwest of the city. Contracts for the material have been let. This line will be extended to Webb City also, and eventually to Grand Falls. The company has increased its capital $100,000. A corporation has been organized under the name of the Joplin and Grand Falls Electric Railway company to build a line from Joplin to Grand Falls, four miles southwest. The big plant of the Southwestern Electric Light & Power company is located at Grand Falls, and it is the purpose of this company to construct a lake above the falls and build a big hotel. The electric railway has a capital of $100,000, and its incorporators are among the wealthiest citizens of Joplin.

THE TELEPHONE.

The Pacific Telephone Attachment and Record company of San Francisco has been incorporated with a capital stock of $100,000.

John Lynch, who says that he is the inventor of an electric wire conduit, has brought suit against the Pacific Bell Telephone company, alleging that it has infringed upon his patent in its underground service.

THE TELEGRAPH.

Craig City, Va , rejoices because it now has telegraphic communication with the rest of the world.

Swain Arnold has introduced a bill in the Illinois legislature providing thas all telegraph companies shall pay a tax of 3 per cent. on its gross income received within the state.

John C Wilson an electrical engineer of Boston, writes to the *Herald* of that city proposing an "aerial tunnel" for telegraph and telephone wires. These tunnels, he says, could be erected along the lines of railways, and constructed of glass and iron or steel, and could easily be made strong enough, he thinks, to weather any storms without injury. The wires, he believes, could readily be secured on the inside of these tunnels.

In the United States Circuit court at New York last week Judge Lacombe decided against the government in a suit brought to recover $12,495 from the Union Pacific Railway company and the Western Union Telegraph company as a rebate on messages. The dispute arose over messages sent during war times from Council Bluffs to Ogden and from Kansas City to Boaz. The government granted privileges to the Union Pacific for the consideration of roadway and telegraph lines and in return was to be allowed certain privileges regarding certain messages. No provision was made as to whether messages should be sent over the railroad or the Western Union wires, and the telegraph company transmitted the messages and refused any rebate.

A dispatch from Petersburg, Va., says: "The litigation between the Postal Telegraph Cable company, on the one side, and the Norfolk & Western Railroad company and the Western Union Telegraph company, on the other side, growing out of the Postal company's proceedings to obtain by condemnation a telegraph right of way along and on the roadway of the railroad company, has been resumed. The main point is whether or not the laws of Virginia authorize the condemnation of a telegraph right of way along a railroad. The court overruled the motion of the defendant company to dismiss the proceedings and granted the motion of the plaintiff company, and designated Tuesday, March 3, 1891, for the commissioners to assemble and assess the compensation to be paid by the Postal Telegraph company to the Norfolk & Western for the right of way along its line. There will be an appeal."

Personal Mention.

Jesse Scribner, of Boston, private secretary to S. A. Barton, president of the Brush electric company, is visiting Chicago.

M. J. Carney has been appointed superintendent of the Central Union Telephone company for Ohio. His headquarters will be Columbus. William J. Madden has been appointed Mr. Carney's assistant.

George H. Bliss has returned from his Southern trip. While his journey was undertaken partly for business reasons, Mr. Bliss' many friends will be gratified to learn that he comes back much improved in health.

Miscellaneous Notes.

The Jacksonville, Fla., street railway company has applied to the city council for authority to operate its lines by electricity.

D. B. Lacy, of Oxford, Ala., has secured the contract to build the Anniston extension of the Oxford Lake line.

The Wenstrom Consolidated Dynamo & Motor company of Baltimore will, it is reported, issue $250,000 of bonds.

An electric indicator has been adopted by the Water Board of Lowell, Mass., to indicate the fluctuation of pressure in the mains, and detect leaks.

The Allentown Passenger railway company has been sold to the Industrial Improvement company of Boston, Mass., which, it is said, will greatly extend the lines to Bethlehem, and operate the system by electricity.

Anson Van Slyck, who represented himself as the agent of a Chicago electric company, was arrested in Buffalo last week on the complaint of Frank Achille, who claims that Van Slyck sold him bogus patent rights in electrical appliances. The amount involved is about $2,000.

In its issue of February 28th, *Modern Light and Heat* of Boston published a "Portrait Gallery of the Providence Convention," containing five full page groups of prominent members of the fraternity. There are eighty-seven persons included in this collection, covering pretty fully the whole range of electrical industry.

The authorities of the Ohio penitentiary have been using an electric shock for the purpose of punishing inmates. Somebody charged that the prisoners were being frightfully tortured by the practice. and an investigation was ordered by the legislature. So far the committee has been unable to find that any atrocities have been committed.

The development which has taken place in the application of electricity to lighting, power and other purposes in Germany during the past few years has induced the German government to draft a measure to exercise control over electric lighting stations, overhead and underground wires, installations and factories where electrical apparatus is made.

According to London *Industries* M. Cailletet has devised a simple method for connecting glass tubes to metal work in the construction of physical apparatus. The end of the glass tube is first gently warmed, and then covered with a few drops of a solution of neutral platinum chloride and chamomile oil On gently warming the tube to a dull redness the platinum salt is reduced to the metallic state, and a brilliant deposit of the metal is formed on the end of the tube. The tube is then connected to the negative electrode of a battery and immersed in a bath of copper sulphate, when the copper is deposited as a malleable adherent coating on the platinum flux. A material is thus formed which can be brazed on to brass or copper in the ordinary way.

Business Mention.

The Electrical Supply company of Chicago reports among its week's sales of Ajax dry batteries one lot of 2,000.

Woodbridge & Turner, electrical engineers and contractors, have removed from 74 Cortlandt street, to 47 *Times* building, New York City.

The Eastern Electric Cable company of Boston is introducing a new wire known as "Hub Line wire." It has also issued a new price list for its Clark wire.

Attractively printed circulars, setting forth the merits of the Simpson storage battery, the Ajax dry battery, new high insulation brackets and the Sunbeam incandescent lamp, are being sent out by the Electrical Supply company of Chicago.

The Electrical Supply company of Chicago has just issued a supplementary catalogue, giving cuts and descriptions of the Weston voltmeters and ammeters, together with many new electric fixtures, insulation brackets, cut-outs and other devices.

A one-horse power slow speed Crocker-Wheeler motor was set up in the United States District Court, Post-office building, recently, to run a lynotype to show its workings in a patent suit. The motor elicited much favorable comment and was examined by the judges.

The Lunkenheimer Brass Manufacturing company of Cincinnati announces that it has purchased the entire plant and good will of the Porteous Brass Manfacturing company of that city. This company manufactures engine builders' and steam fitters' brass work, as well as well-known specialties in valves, lubricators and oil cups.

The Great Western Electric Supply company of Chicago, has reduced the prices of incandescent lamps. The company has recently made arrangements with one of the largest lamp factories in the country, to take the entire outfit, and it is able to quote factory prices. The company has been overwhelmed with orders, and has found it necessary already to increase the facilities of the factory.

The Eureka Tempered Copper company of Northeast Pennsylvania has arranged with the American Railway Equipment company of New York and Chicago to act as its general agents with railroads in all territory west of the Mississippi river It reports large orders from the Edison General Electric company, the Wenstrom Consolidated Dynamo and Motor company, the Electro-Dynamic Motor company, the National Electric Manufacturing company and the Baxter Electric Motor company for its tempered copper during the month of February, and in finished work for electrical central stations has received upward of one hundred orders during the month of February

alone. It has also received many commendatory letters from companies using its specialties.

The Central Electric company, Chicago, which is the general Western agent of the Okonite company, announces that it has booked orders during the last week for more than 2,000 000 feet of varied sizes of Okonite. The company is making a specialty on hard rubber goods, offering the products of the Butler Hard Rubber company, New York, and making prompt shipments. The company is introducing a compound that takes a good finish, and is especially recommended for its insulating qualities. The company is in receipt of a letter from J. Parker & Son, Chicago, in which they state that they have had three Burnley dry batteries in constant use for two years and that they have been successfully operating six 3-inch bells, which upon a recent test were working as satisfactorily as when first put in. The company reports the largest sales yet recorded on this battery during the month of February. As the sole western agent for the Paiste-Edison key sockets, the Central Electric company has already had numerous large orders. The latest improved socket is virtually a 5-ampere Paiste switch mounted in a handsomely finished shell.

A finely illustrated 200 page general catalogue of blowers, heating and drying apparatus, portable forges, engines, etc., has just been issued by the B F. Sturtevant company, Boston, Mass. It is devoted principally to the general line of goods and method of introduction, as special catalogues are published relating to the different departments of work. In the introduction the following occurs: "The first comprehensive and authentic tables and diagrams relating to the action of air under pressure, and to the speeds, pressures, capacities and powers required upon all classes of blowers were published in our celebrated catalogues of 1870 and 1873. The information and tables therein contained have formed the basis of all computations upon the movement of air by fans, and have been extensively copied, but not originated, by other manufacturers. The constant demand by engineers for these tables has led to their careful revision, and the introduction of much new material, and they are here presented as the only authentic data published relating to fan blowers." The catalogue bears marked evidence of the prosperity of this concern and of its thorough acquaintance with the branch of engineering of which it treats.

When the Wenstrom Consolidated Dynamo and Motor company, came before the public last spring, it was the belief that it could supply the demand for its machines from the old works until the new factory could be completed in September. So rapidly, however, was the selling department of the company organized, that the facilities of the factory were soon overtaxed, and the result was that the company was unable to fill orders promptly. Every effort was then turned toward the rapid completion of the new factory at Calverton Heights, Baltimore, Md. Many annoying delays arose, but Mr Tunis, the president of the company, pushed ahead in spite of the numerous difficulties and his efforts were at last crowned with success in the completion of the present factory. The building is 100 feet front by 260 feet deep. It is two stories high in front and four in the rear. No effort has been spared to make it the most substantial and complete electrical factory in the country. The building as stated, is situated at Calverton Heights, where there is one of the finest water powers in the state. The company purchased this entire property, consisting of nearly 100 acres, with the view of erecting as the business demanded, a series of factories similar to the first. The design was also to afford ample room for houses for their workmen and the laying out of a small town which must necessarily rise about such an important manufacturing center. H. F. Parshall, an expert electrician, has charge of the electric work connected with the Wenstrom company and he has fitted up the factory with a line of high class tools which will enable the company to turn out work with great rapidity. Mr. Parshall has also been at work remodeling the old Wenstrom machines. No expense has been spared to enable the Wenstrom company to compete with other companies doing a high class of work.

Electrical Patents.

Issued March 4, 1891.

446,417. Conduit Electric Railway. Edward M. Bentley, New York, N. Y.

446,418. Electric-Line Switch. Edward M. Bentley, Boston, Mass.

446,419. Electric-Railway Conduit. Edward M. Bentley, Boston, Mass.

446,420. Contact Device for Electric Railways. Edward M. Bentley, Boston, Mass.

446,424. Telegraphy. Robert G. Brown, Brooklyn, N. Y.

446,425. Telegraphy. Robert G. Brown, Brooklyn, N. Y.

446,428. Contact-Trolley for Electric Railways. James B. Caboon and Isaac F. Baker, Lynn, Mass.

446,459. Electric Arc Lamp. John A. Mosher, Abilene, Kan.

446,475. Electric Railway. Nicholas Seibert, Malden, Mass.

446,477. Moisture-Protection Hood for Lamps. Andrew Shillinglaw, Chicago, Ill.

446,483. Electric-Railway Conductor. Elihu Thomson, Lynn, Mass.

446,488. Magnetic Tachometer. John Waring, Manchester, Conn.

446,489. Electrical Measuring-Instrument. Edward Weston, Newark, N. J.

446,490. Rheostat. Edward Weston, Newark, N. J.

446,491. Electrical Measuring-Instrument. Edward Weston, Newark, N J.

446,492. Electrical Measuring-Instrument. Edward Weston, Newark, N. J.

446,493. Electrical Measuring-Instrument. Edward Weston, Newark, N. J.

446,494 Electrical Measuring-Instrument. Edward Weston, Newark, N. J.

446,509. Electric Lock. Edward J. Colby, Chicago, Ill.

446,515. Electro-Magnetic Cut-Out. Ludwig Gutmann, Pittsburg, Pa.

446,527. Secondary Battery. Arthur M. F. Laurent-Cely, Paris, France, and Illius A. Timmis, London, England.

446,536. Commutator and Brush. Horace F. Parshall, Baltimore, Md.

446,544 Battery Compound. William Wright, New York, N. Y.

446,546. Electric Railway-Signal. William S. Cook and Moses C. Cook, South Omaha, Neb.

446,549. Disk-Carbon Holder for Electric Lamps Edwin C. Russell, Boston, Mass.

446,613. Controlling-Switch for Electric Railway. Frank B. Rae, Detroit, Mich.

446,614. Telephone Call. David H. Rice, Lowell, Mass.

446,623. Electric Switch. George R. Lean, Boston, Mass.

446,641. Annunciator. John H. Elfering, New Haven, Conn.

446,655. Electric-Conductor Connection. Heinrich Arld.

446,660. Carbon for Electric Lamps. William H. Burns, Los Angeles, Cal.

446,661. Magneto-Electric Machine. George P. Clark, New York, N. Y.

446,666. System of Electric Lighting. Thomas A. Edison, Menlo Park, N. J. Application filed June 26, 1882.

446,667. Locomotive for Electric Railways. Thomas A. Edison Menlo Park, N. J.

446,668. Electric Arc Light. Thomas A. Edison, Menlo Park, N. J. Application filed August 7, 1882.

446,669. Manufacture of Filaments for Incandescent Electric Lamps. Thomas A. Edison, Menlo Park, N. J.

446,684. Electric Music-Box. Charles A. Hussey, New York, N. Y.

446,703. Electric Fire-Engine. Mark W. Dewey, Syracuse, N. Y.

446,704. Magnetic Pulp-Separator. William C. Edwards, Holyoke, Mass.

446,706 Amalgamating Apparatus. Thomas Gemmell, London, England.

446,712. Electric Call Bell. David H. Rice, Lowell, Mass.

446,727. Pyro-Chemical Battery. John Blair, North Orillia, and Alexander G. Hunter, Dundalk, Ontario, Canada.

446,730. Induction-Coil. Fred H. Brown, Chicago, Ill.

446,732. System of Electric Calls. Jacob B. Currier and David H. Rice, Lowell, Mass.

446,767. Magnetic Ore-Separator. Charles G. Buchanan, New York, N. Y.

446,801. Electric Regulating Clock. Desire Van de Plancke and Gustave Van de Plancke, Courtrai, Belgium.

446,817. Electrically-Propelled Car. Rudolph M. Hunter, Philadelphia, Pa.

446,821. Electric Locomotive. Eben M. Boynton, West Newbury, Mass.

446,826. Detachable Ceiling Blocks or Bracket for Electric Lamps. Herbert C. Wirt, Boston, Mass.

446,831. Electric Heater. Thomas J. Donovan, Chicago, Ill.

The last claim is given:

"6. The combination of a fluid-reservoir with one or more carriers, electric heaters pivoted thereon, and operating mechanism for manipulating such pivoted heaters."

446,833. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

446,834. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

447,291. Electric Dental Motor. Harry H. Blades, Detroit, Mich.

447,315. Incandescent Lamp Socket. Harry J. Gutman, Des Moines, Ia.

447,321. Electric Matrix-Making Machine. Thomas C. Hargrave, Minneapolis, Minn.

447,332. Electric Railway. Walter H. Knight, New York, N. Y.

447 338. Conduit for Underground Trolley-Wires. Horace J. Medbery, Ballston, N. Y.

The conduit is made, essentially, of fiber pulp and of substantially tubular form, the meeting edges, however, of which are not coincident either in circumferential or radial lines.

447,350. Electrical Subway. John C. Reilly, Brooklyn, N. Y.

447,352. Commutator Brush. Edwin W. Rice, Jr., Lynn, Mass.

447,353. Electric Heater. Charles C. Rich, Mount Vernon, N. Y.

The invention consists of a heat absorbing core provided with washers of an absorbing and radiating nature, and coils of insulated wire wrapped about said core or center between the washers, thus absorbing the heat from the inner part of the coils and bringing it to the surface for radiation.

447,383. Electric-Arc Lamp. Elihu Thomson, New Britain, Conn.

447,384. Dynamo Electric Motor or Generator. Elihu Thomson, Swampscott, Mass.

The last claim follows:

"9. A commutator composed of segments having radial slits, and screw-tapped holes communicating with the slits, in combination with the armature-wires laid in the respective slits, and the screw plugs holding the said wires in place."

447,385. Weighing and Packing Machine. George D. Van Hoesen, Brooklyn, N. Y.

447,409. Electric Time Lock. Joseph H. Kaiser and Andrew B. Ledwith, Brownsville, Pa.

447,426. Telephone-Switch System. Claude C. Gould, Batavia, N. Y.

447,449 Matrix-Making Machine. Thomas C. Hargrave, Minneapolis, Minn.

447,469. Commutator-Brush. William Main, Brooklyn, N. Y.

The invention consists in the combination, with a commutator and a brush-carrier, of a commutator brush consisting of a series of parallel plates inclined to the surface of the commutator and having their contact edges parallel to the plane of rotation of the commutator or brush-carrier, said plates being independently pivotally mounted in the carrier, and means for pressing the plates together and holding their contact edges against the commutator.

447,482. Electric-Lighting System. Barton B. Ward, New York, N. Y.

The invention relates to means for maintaining the resistance practically equal and constant in several multiple arc branches, including translating devices—for example, arc or incandescent lights.

447,485. Telephone Exchange Apparatus. Franklin G. Beach, Chicago, Ill.

By the use of this invention in a telephone exchange single lines can be utilized for metallic circuits without the necessity of furnishing additional wires for the return circuit, which ordinarily and otherwise would be essential to form such single lines into metallic circuits.

This system enables one to group the single lines in such manner that the subscribers may each be provided with complete metallic circuits for talking without materially increasing the expense for wire over and above the expense of single circuit-lines, and at the same time the switch-board apparatus is very materially reduced.

447,486. Universal Joint for Incandescent-Lamp Brackets. Edwin C. Bennett and Elisha C. Freeze, Chicago, Ill.

The claim reads:

"The combination, in a ball-and-socket joint provided with an opening for a pair of flexible conducting wires, of insulating material at the portion thereof which comes against the wires, the socket of said joint being formed of a cup and cap said cap being adapted to be screwed over the cup to form an adjustable frictional clamp between the ball and socket, and a reversible frictional ring open on one side, placed in the cup and serving as a bearing or seat for the ball when in position."

447,494. Rheostat. Jeremiah O'Meara, New York, N Y.

447,495. Turn-Out and Crossing for Line Conductors. Sidney H. Short, Cleveland, O.

We give the first claim:

"In a two-wire system of line conductors for electric railroads, the combination of the two trunk or main line trolley-wires with two curved branch trolley wires, one of which crosses a main wire and both affording continuous electric trolley contact."

447 529 Electro Magnetic Cut-Out. Giles Taintor, Worcester, Mass.

447,558. Electrical Annunciator. William E. Cram, Cambridge, Mass.

447,569. Electrical Transformer. Rankin Kennedy, Glasgow, Scotland.

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447,626. Backing for Electrotype or Stereotype Shells. Jacob C. Wolfe, New York, N. Y.

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447,632. Trolley for Electric Railways. William J. Cavert, Albany, and William P. Wiswall, West Troy, N. Y.

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447,740. Electric-Arc Lamp. Luther H. Buchanan, Pasadena, Cal.

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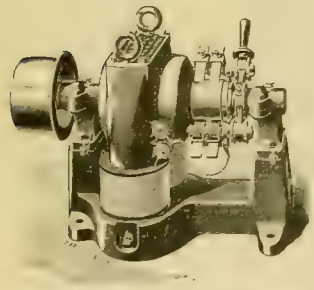

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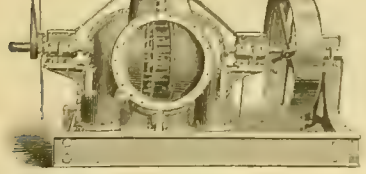

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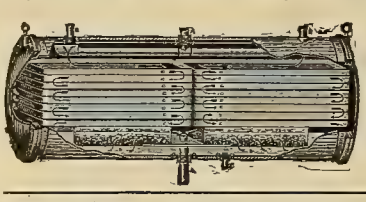

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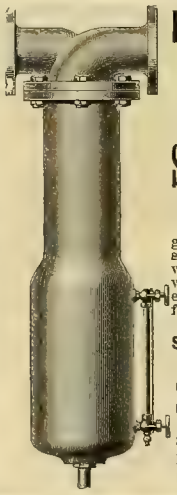

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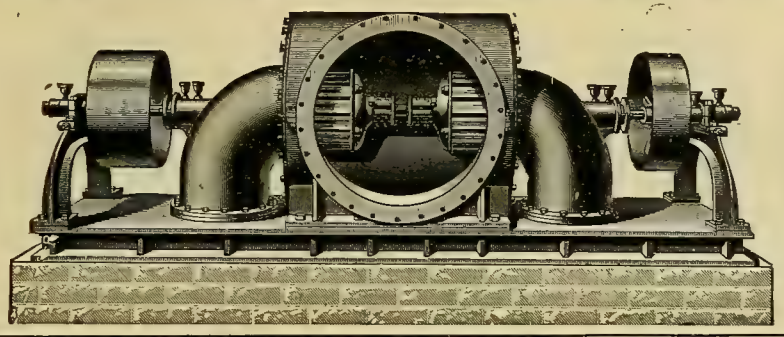

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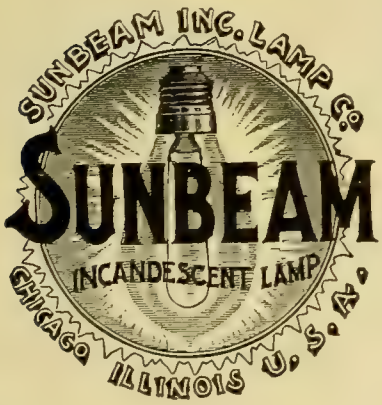

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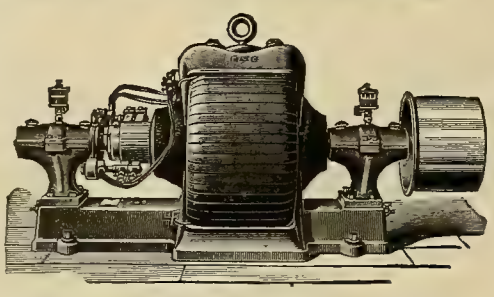

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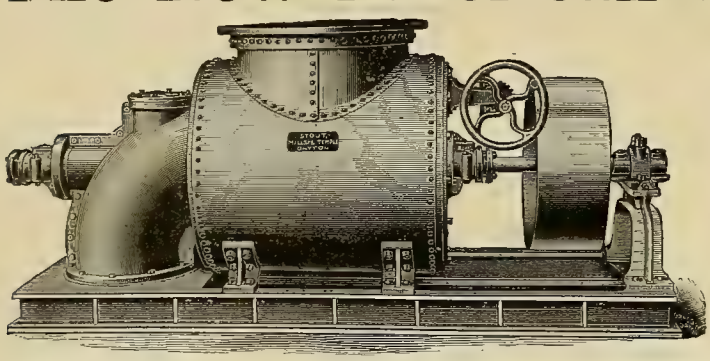

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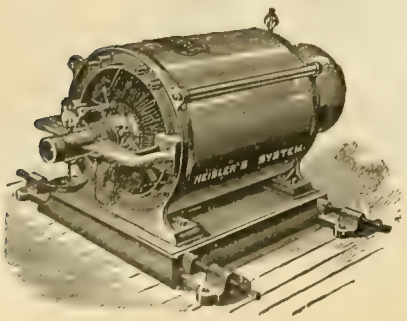

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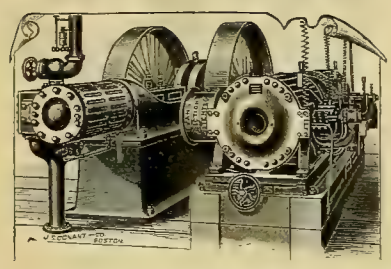

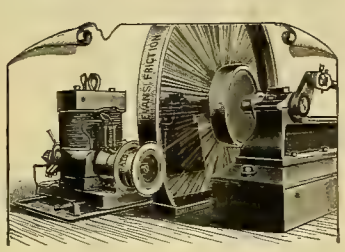

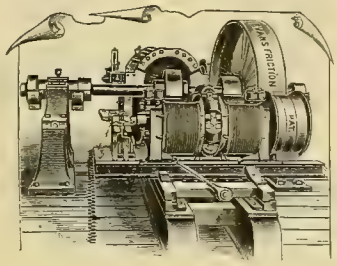

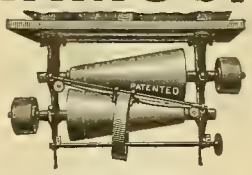

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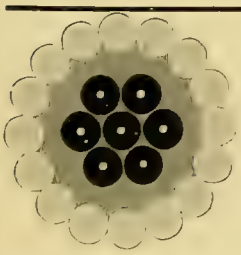

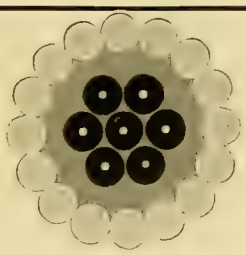

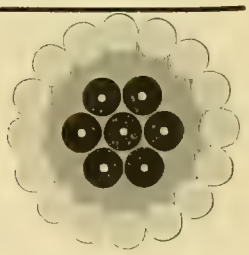

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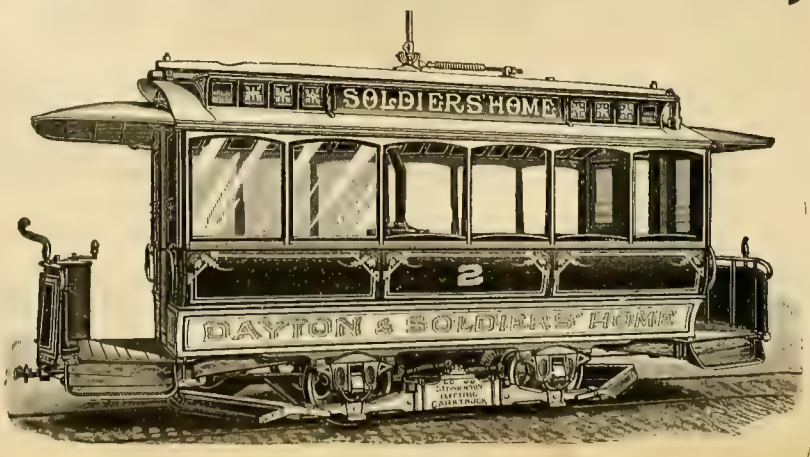

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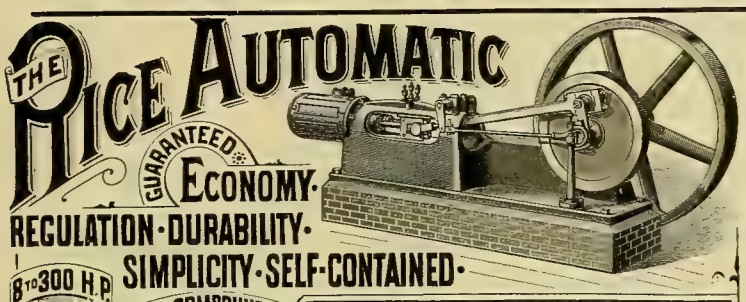

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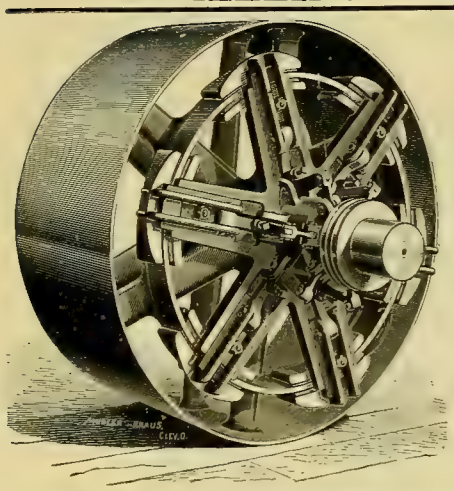

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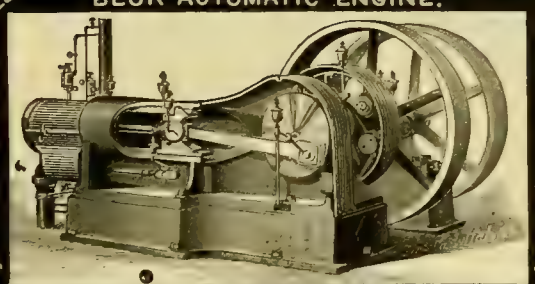

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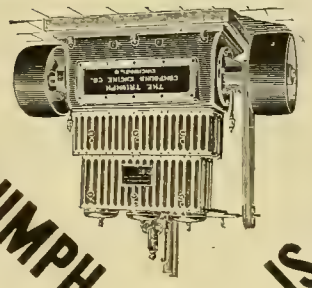

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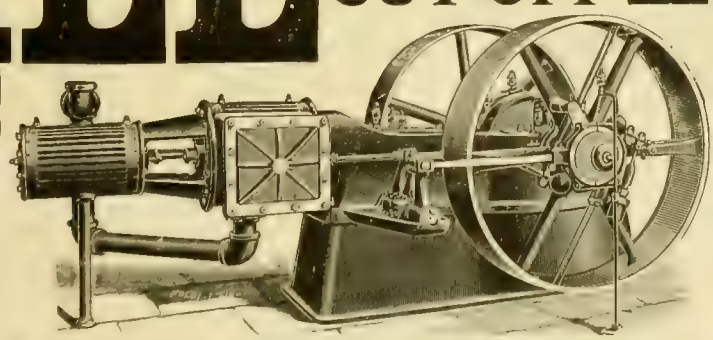

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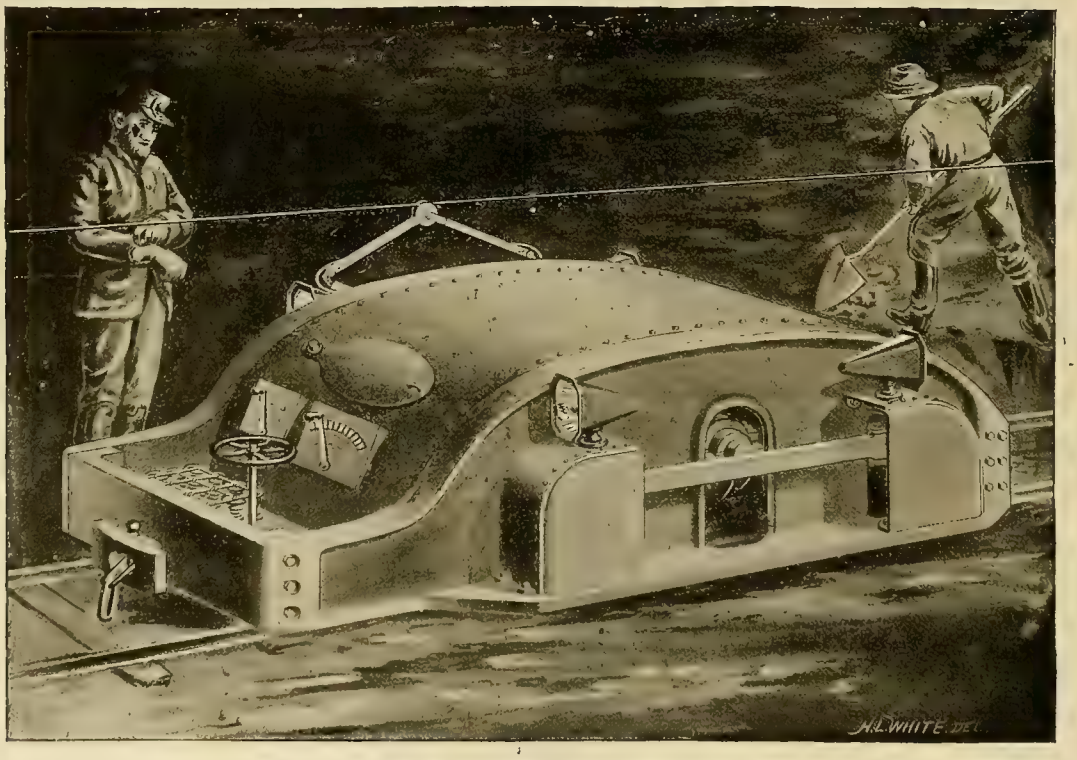

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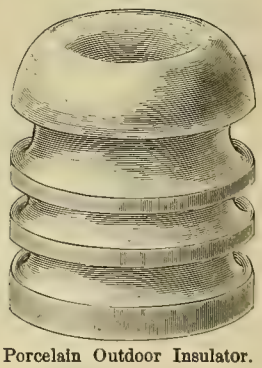

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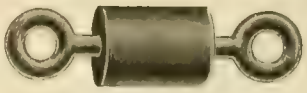

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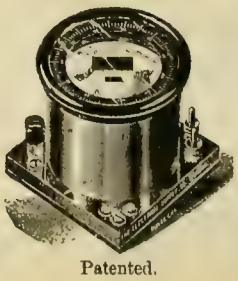

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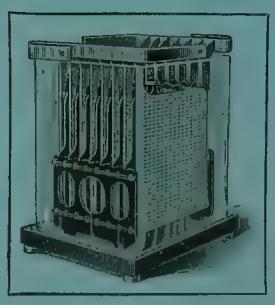

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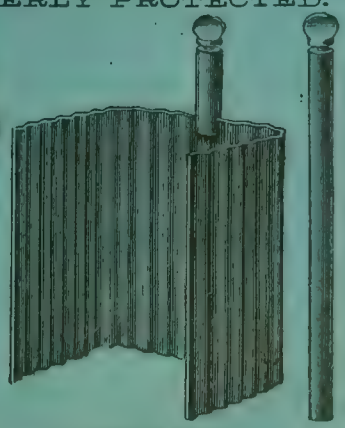

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31,950	TOTAL,	16,153

Nearly double as many of the Thomson-Houston System as of

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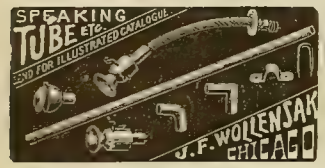

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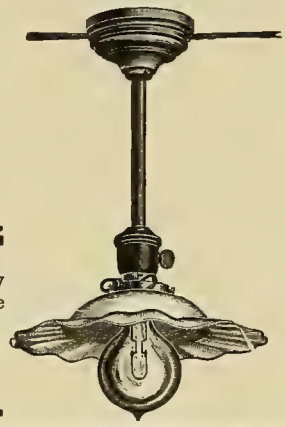

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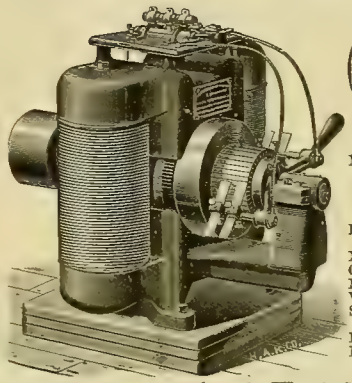

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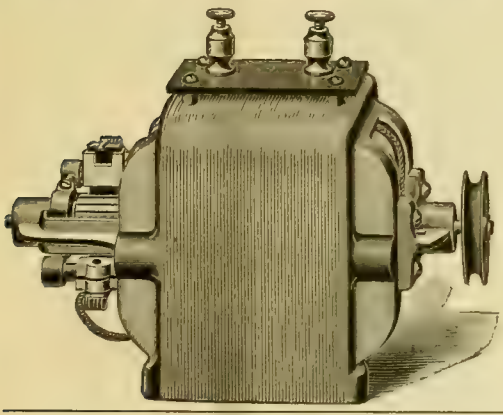

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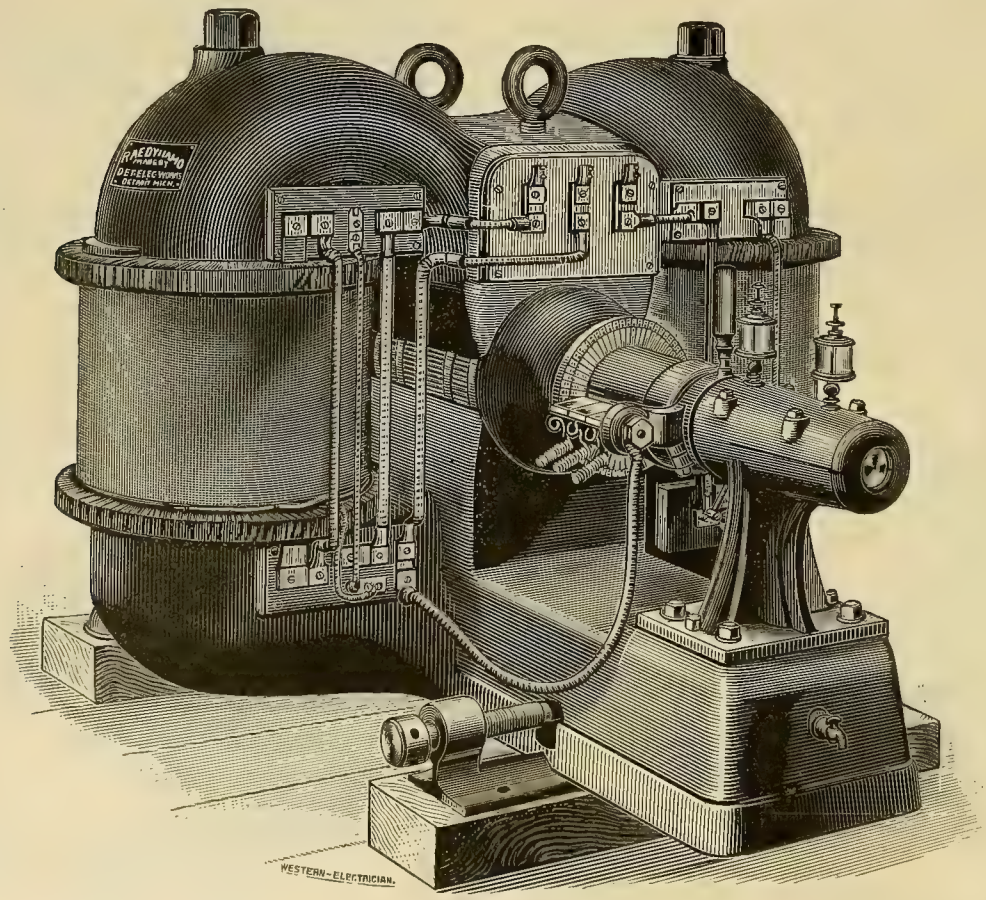

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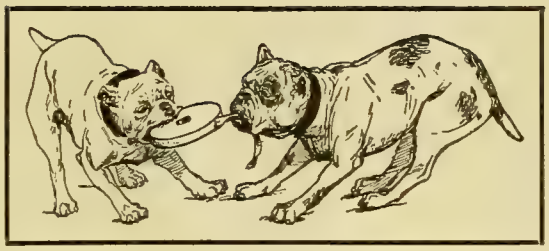

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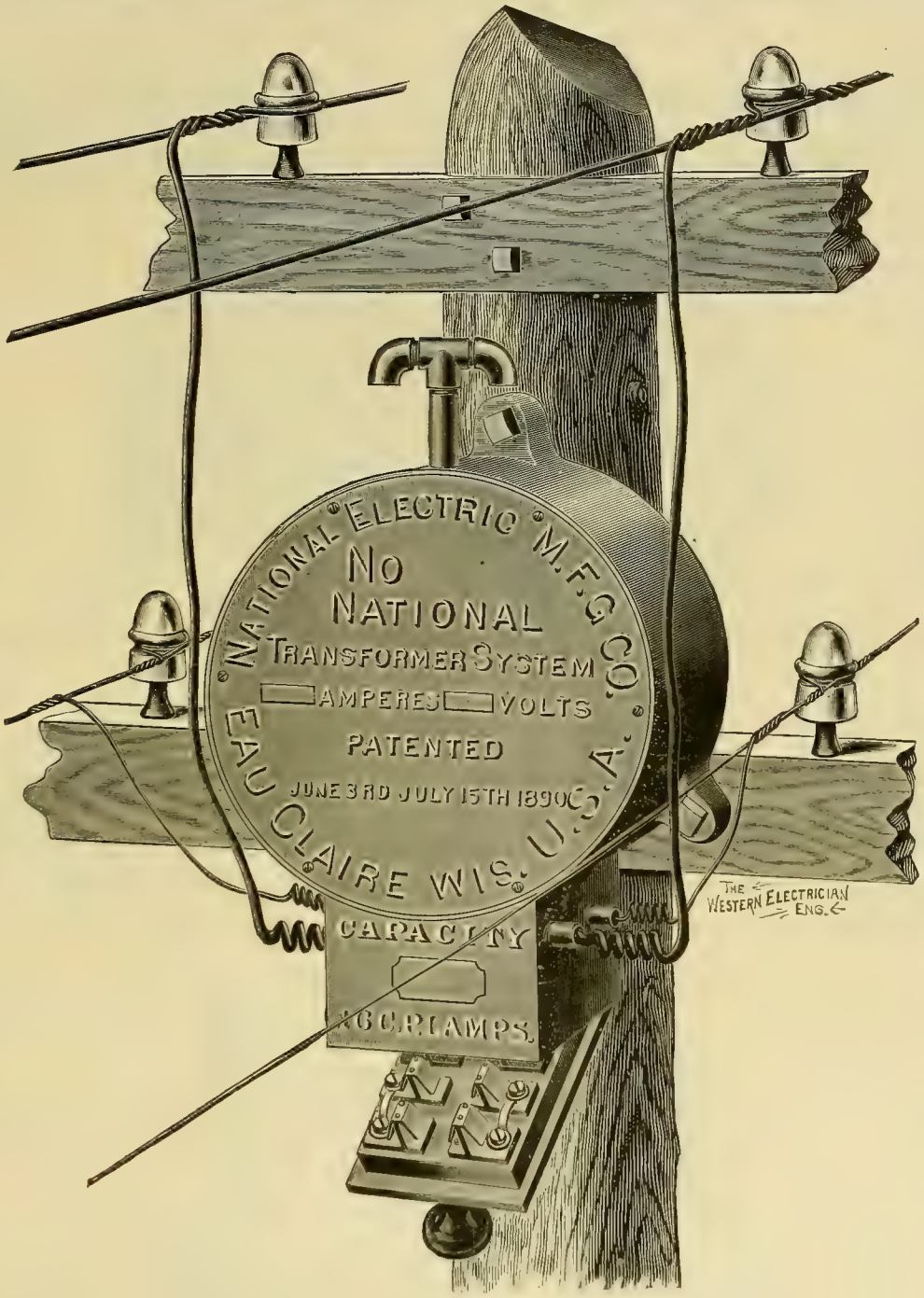

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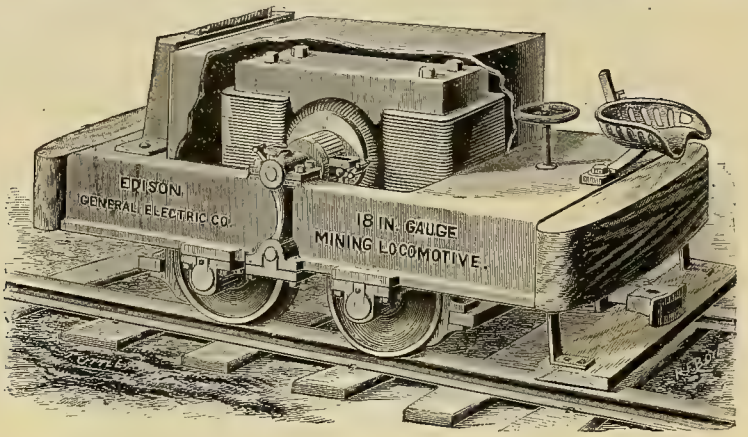

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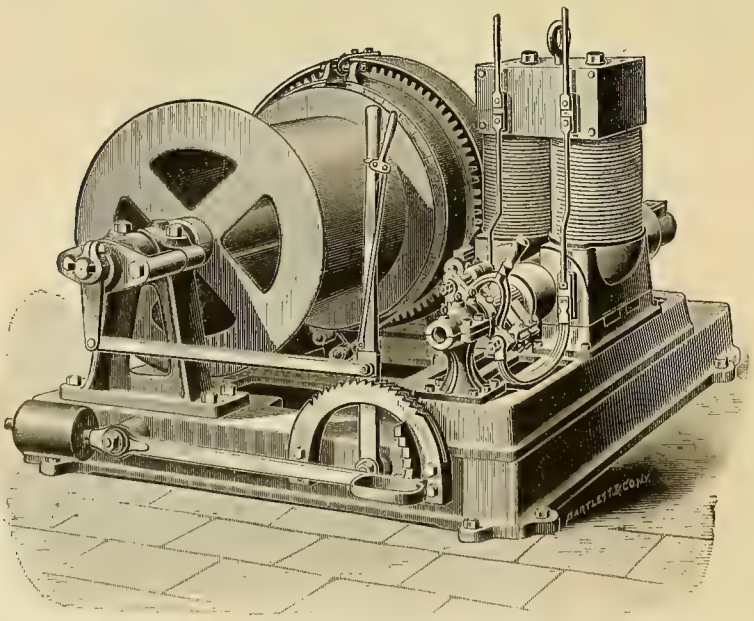

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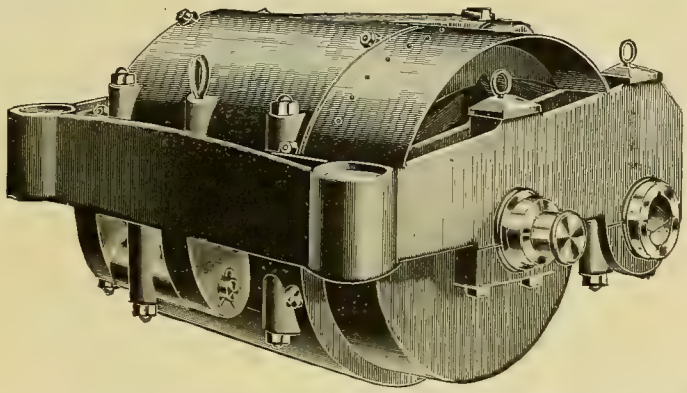

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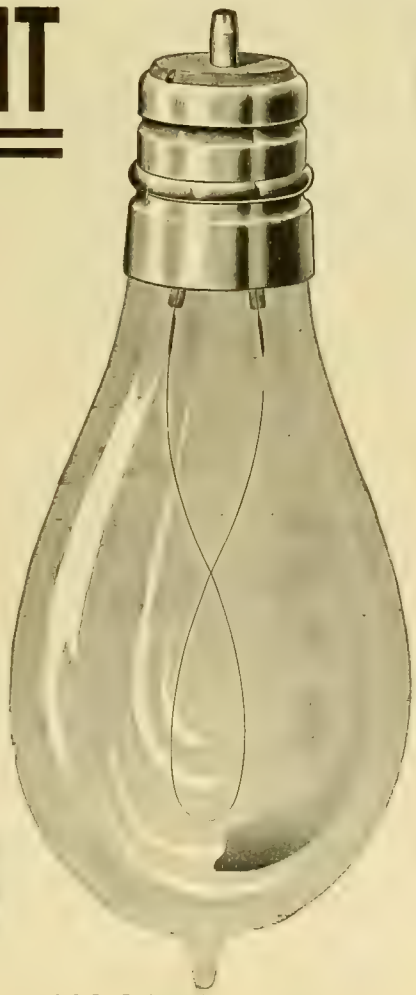

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Western Electrician.

EVERY SATURDAY.

Vol. VIII. CHICAGO, MARCH 21, 1891. No 12.

Foree Bain.

No inventor is better known in electrical circles in Chicago than Foree Bain, president of the Bain Electric Manufacturing company. The records of the Patent Office indicate how assiduously and how successfully he has applied himself to the study of electrical problems. Above all, Mr. Bain is practical; no one who has met him has failed to be impressed with that fact. As an inventor he has worked to secure results which could be utilized to accomplish an immediate purpose. Mr. Bain has occupied a unique position in Chicago. An independent electrical engineer, he has operated individually an extensive shop devoted exclusively to electrical work, to which inventors with electrical ideas applied for assistance. The number of vague plans which Mr. Bain has developed is legion.

Personally Mr. Bain is popular with the electrical fraternity; it would be hard to point to a member of the craft whose good nature was more uniform, whose courtesy was more thoughtful, or whose kindly regard for his fellow man was more pronounced.

Mr. Bain was born in La Grange, Oldham county, Kentucky, in 1853. He is a direct descendant of the Scotch electrician of telegraph fame, Alexander Bain, whose logic and moral science are standard works. Mr. Bain has come honestly by his reputation as an electrical engineer. When 15 years of age he was in charge of a telegraph station. In 1878 he was appointed manager of the electrical work in an extensive electrical manufactory in Cincinnati. For several years he remained in that position, developing an electric lighting system.

In 1881 Mr. Bain came to Chicago to exploit his electric lighting system. He formed a company with Captain E. A. Goodrich of the Goodrich Transportation company, and the corporation organized a large manufacturing establishment. The death of Mr. Goodrich necessitated the close of the factory.

Mr. Bain then organized an establishment of his own, and has since done an extensive business. He was a pioneer in the application of electric motors to mining work, and in this field has made a number of valuable inventions. He has designed a number of motors and generators especially adapted for this class of work. Mr. Bain has devoted himself to no single department of electrical engineering. In his shop have been developed devices and appliances designed for all branches of electrical work.

When the street car company operating the lines in Minneapolis and St. Paul decided to operate its cars by electric motors, Mr. Bain was secured as consulting engineer. He has devoted a great deal of time to working out problems connected with the construction work. Many departures from methods ordinarily followed were suggested by Mr. Bain, and were adopted by the company. These innovations have since been found to contribute in no small degree to the successful operation of the road. In all conditions of working the lines in the twin cities have proved satisfactory. The officials of the company say the extraordinary care which was exercised during the construction period affords an adequate reason for the fact that they have had little or no trouble in the operation of the system. That the work was done in such a substantial and thorough manner was due to the fact that a great part of it was done under Mr. Bain's supervision, and that it embodies a great many of his ideas.

FOREE BAIN.

Electrical Section of the World's Fair.

Prof. Barrett has decided to make the historical portion of the electrical department of the World's Columbian Exposition one of the most attractive features of the Fair. He will endeavor to secure a complete line of devices in all branches of the art, illustrating the gradual development down to the present time. This will be of special interest to students and to the public generally, and it will not be without value to the manufacturing companies, as it will give the public some idea of the patience and toil required of the pioneers and of the great expenditure of money that was necessary in the development of the several branches of electrical industries. All who are interested in electrical pursuits will no doubt gladly assist the chief of the electrical department in his labors, as all will feel a personal pride and gratification in displaying the wonderful advances that have been made in the application of electricity to commercial uses.

Prof. Barrett has already opened correspondence with many of the "old timers" with a view of securing data and models which will be appropriate for the exhibition. The celebration at Washington next month will afford him an excellent opportunity to present his views to the inventors who will assemble there to commemorate the beginning of the second century of the American patent system. Furthermore, an effort will be made to secure for the exhibition many interesting models now hidden in obscure corners in the patent department which will illustrate the ideas of the early inventors of electrical devices.

Electrical societies throughout the country will be interested in this cause. Much assistance is expected from this quarter. They should certainly take a special interest in this department, and ought to facilitate the work of the electrical bureau.

English electrical engineers are evidently much interested in the preparations of the electrical section of the World's Columbian Exposition. The London *Electrician* reproduces from the WESTERN ELECTRICIAN an abstract of the report of the committee of the Chicago Electric club relative to the lighting of the buildings and grounds of the Exposition. The same exchange comments as follows editorially: "The report of the committee appointed to make recommendations with regard to the electric lighting of the proposed Chicago exhibition, an abstract of which will be found in another column, contains some figures of interest. The complete publicity which ought to be given in the details of exhibition lighting should afford much useful information as to the economy of various methods of illumination. Unfortunately for us in this country, it is suggested that the tower system, which has often been tried and is far from popular, should again be used. We say unfortunately, because the experience gained with this mode of lighting in the clear air of Chicago can be of little service to an English engineer, particularly to one who has to provide for the lighting of London. When the sun itself cannot succeed in penetrating our fogs for days together, it is unadvisable to place a lamp more than eighteen feet from the ground. But it is not proposed, in the present case, to erect the enormous structures that have been frequently designed and occasionally tried in America, the height of seventy-five feet being suggested as the best elevation."

Referring to another point in the report the *Electrician* says: "The report of the committee asserts, as if it were a well-known Chicago fact, that for the best effect, the height of the lamp should be seven-tenths of the radius of the area to be illuminated by it. The study of the distribution of illumination has been very much neglected, and the literature of the subject is very meager, but we cannot admit that there is any best ratio between the height of a lamp and the radius of the area which it lights. The closer the lamps are placed the more uniform is the illumination, and the greater will be the expense."

Frederick Sargent, whose appointment as consulting electrician to the chief of construction of the World's Columbian Exposition was announced in the WESTERN ELECTRICIAN last week, has entered upon the discharge of his new duties. Hereafter Mr. Sargent may be found in the office of Mr. Burnham, in the Rookery building.

On Tuesday the headquarters of the electrical department of the World's Columbian Exposition were established at rooms 501 and 503 Rand-McNally building, and here the secretary will hereafter be found. Mr. Hornsby will be happy to impart information about the department at any time.

Prof. Barrett will endeavor to have a conference with the representatives of the leading electric companies of the country at an early day, with a view of obtaining their ideas on the question of exhibits. His own views were expressed in the paper prepared by him for the National Electric Light association last summer.

It is expected that the blue prints of the floor plans for the electrical buildings will be ready in two or three weeks. Then the department can begin to consider applications for space.

A new classification of the exhibits in the electrical department will be shortly presented to Director-General Davis. Should it meet Mr. Davis' approval, the list will be issued in pamphlet form for distribution.

It is estimated that the electrical building will cost $650,000. It will cover about five and one-half acres, and the style of architecture will be French renaissance.

Tesla's Improvements in Alternating Current Generators.

The alternating current dynamos generally used at the present time do not deliver current at a high rate of alternation. Recognizing that for a number of reasons there would be an advantage in employing generators capable of producing a very great number of alternations per second, Nikola Tesla of New York has designed the two types of machines illustrated in the cuts.

These dynamos are to deliver current at a rate of say 10,000 or more alternations per second.

To produce such a high rate of alternation it is necessary to construct a machine with a great number of poles; but such construction, on this account, where efficiency is desired, is difficult. If an armature without polar projections be used it is not easy to obtain the necessary strength of field, mainly in consequence of the comparatively great leakage of the lines of force from pole to pole. If, on the contrary, an armature core formed with polar projections be employed it is evident that a limit is soon reached at which the iron is not economically utilized. To obviate these and other difficulties the form of machine illustrated in Fig. 1 was devised.

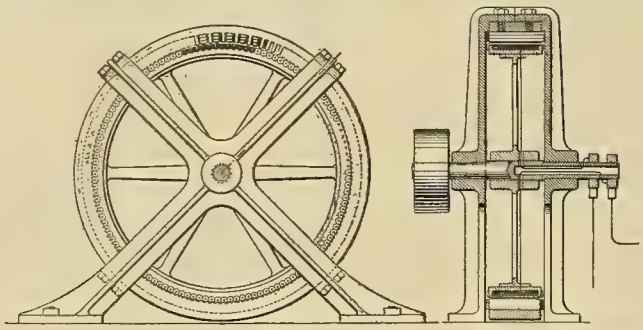


FIG. 2. TESLA'S IMPROVEMENTS IN ALTERNATING CURRENT GENERATORS.

Referring to the cut *A* designates two cylindrical castings provided with bracket arms for the armature shaft. The conductor in which the currents are induced is constructed in the following manner: An annular plate of copper *D* is taken and radial slots are cut in it from one edge nearly through to the other, beginning alternately from opposite edges. In this way a continuous zigzag conductor is formed. To the inner edge of this plate are secured two rings *N* of non-magnetic metal, which are insulated from the copper conductor, but held firmly to it by means of bolts *F*. Within the rings *N* is placed an annular coil. This coil energizes the field magnet. The conductor *D* and the parts attached are supported by means of the cylindrical shells *A*, which are brought together and clamped by bolts to the outer edge of the conductor *D*. The conductor *D* is also insulated from the shell *A*.

The core for the field-magnet is built up of two circular parts *EE*, formed with annular grooves *P*, which, when the two parts are brought together, form a space for the reception of the energizing coil. The hubs of the cores *EE* fit closely against one another, while the flanges which form the polar faces are reduced somewhat in thickness to make room for the conductor *D*, and are serrated on their faces so as to provide polar projections. The two parts of the core are mounted on the shaft and are bound together by bolts. Since the core on one side is of opposite polarity to the part facing it, all the points or projections of one polar face will be of opposite polarity to those of the other face. Therefore, although the space between any two adjacent points on the same face may be extremely small, there will be no leakage of the magnetic lines between any two points of the same name; but the lines of force will pass across from one set of points to the other. This construction it is asserted obviates to a great degree the distortion of the magnetic lines by the action of the current in the conductor *D*. It will be observed the current will flow from the center toward the periphery in one set of radial parts and in the opposite direction in the adjacent parts.

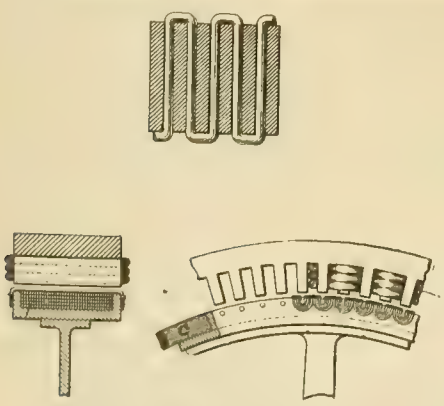


FIG. 3. TESLA'S IMPROVEMENTS IN ALTERNATING CURRENT GENERATORS.

The core, when rotated, generates in the conductor *D* an alternating current. It will be observed that from the nature of the construction described that this machine is capable of producing an alternating current of an enormously high rate of alternations.

In Fig. 2 a machine is represented which was designed by Mr. Tesla for the special purpose of supplying alternating current arc lamps. In constructing this generator the chief object was to render inaudible the sound emitted by the lamps. With this end in view the generator, as in the case of the one just described, was designed to deliver current at a high rate of alternation. The construction of the machine will be easily understood. Fig. 3 is an enlarged side view and a vertical section of a portion of the machine. There is also shown in the figure a section of the stationary field magnets and the method of winding. In Fig. 3 is shown the armature core, consisting of a winding of fine annealed iron wire. By this design of machine, Mr. Tesla states, 10,000 or 11,000 alternations of current per second may be secured, and if this current be applied to arc lamps, the sound produced by or in the arc becomes practically inaudible.

Electric Lights in Tunnels.

The recent tunnel catastrophe in New York city has attracted general attention to the question of illumination. It is conceded that with the development of a system for lighting these tunnels by electricity, much of the danger will be removed. The *Railway Gazette* publishes a communication, presenting the following plan and accompanying illustration: Let the space between *H* 72 and *H* 86 represent a block section, say three-quarters of a mile long; *D* 72 and *D* 86 are the respective distant signals. The small circles represent incandescent electric lights fastened to the side of the tunnel in such a way as to hang within two feet of the cab window. These are to form a signal system auxiliary to and interlocked with the existing block system. These signals, placed 200 feet apart, are all to be used as cautionary signals, and the series for each block extends from *D* to *D*. When lighted by a current sent from the cabin, they indicate that the track is clear to the next distant signal. A lamp not lighted is a signal to immediately bring the speed of a train under control.

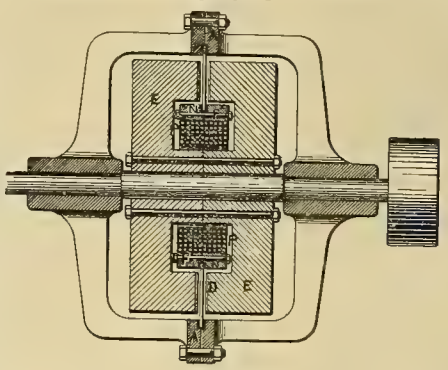
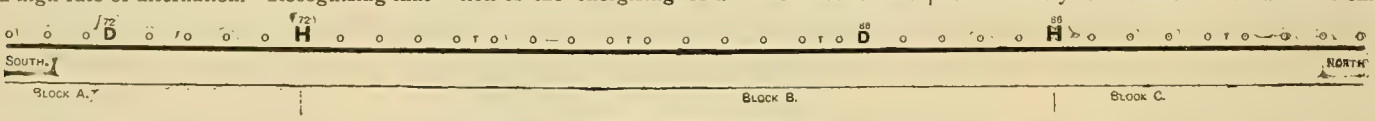


FIG. 1. TESLA'S IMPROVEMENTS IN ALTERNATING CURRENT GENERATORS.



ELECTRIC LIGHTS IN TUNNELS.

In practice this system will work as follows: The operator at *H* 72 pulls off his home signal; this permits him to pull off his distant signal, and unlocks the lever by which he can close the electric circuit to all the lights from *D* 72 to *D* 86. Beyond *D* 86 he has no control over the lights. After the train has passed a light, he shuts off the current from that particular light. If deemed desirable, track levers may be located along the line, as at *T T T*, to enable him to do this promptly; though the ordinary procedure of putting *D* 72 and *H* 72 to danger immediately after the passage of a train, will enable him to unerringly extinguish enough lights to preclude the possibility of wrongfully encouraging any following engineer. The putting of *D* 72 to danger may be made to automatically withdraw the current from three or four lights nearest to it.

Complete Convention Report.

The WESTERN ELECTRICIAN, in its issue of Feb. 28th, publishes a full and complete report of the electrical convention held at Providence, R. I. Its table of the "Comparison of Economy in the Generation of Power," is very instructive to all interested in this economic question.—*Financial and Mining Record*, New York City.

Chicago City Electric Plant, Fourteenth Street and Indiana Avenue.

Another arc light station in Chicago's system of street lighting is finished, and the "Southsiders" are now beginning to appreciate fully the difference between dim gas jets and an arc lamp.

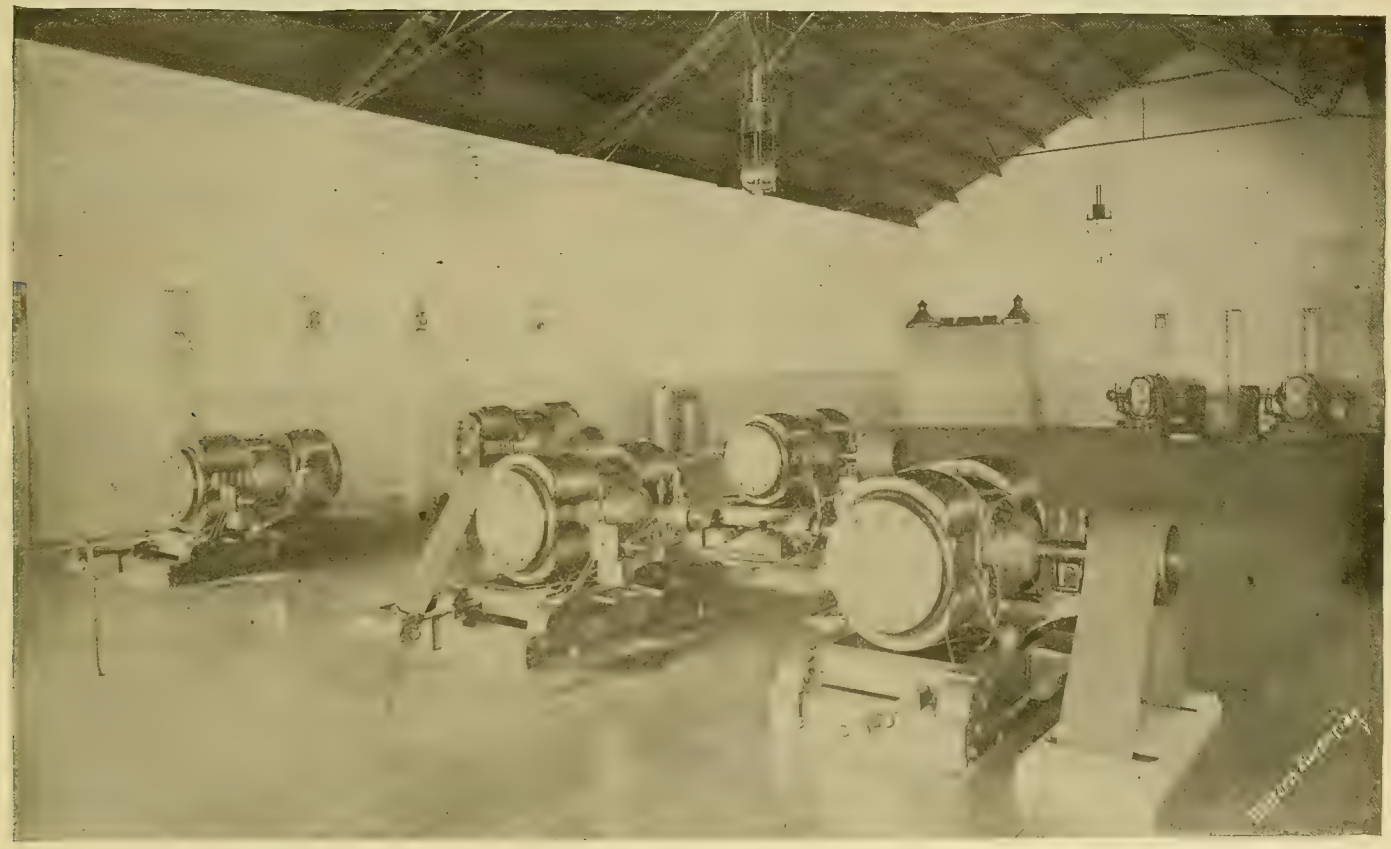
The new plant is located at the corner of Indiana avenue and Fourteenth street. The building is of pressed brick and stone and is two stories in height. It was designed to contain a sufficient number of machines to supply ultimately 850 arc lights. At the present time 191 2,000-candle power lamps, located on the streets of the South Side, are operated from the Fourteenth street plant, but there are 113 additional lamps used in the same district, which are supplied temporarily from the Throop street station on the West Side.

The territory lighted from Fourteenth street station is as follows: All that part of the South Side north of and including Van Buren street; State street as far south as Twenty-second street; Harrison street from State street to the Chicago river; Twelfth street from Wabash avenue to the Chicago river; Twenty-second street from State street to the lake.

The general arrangement of the station is very similar to that of the plants in the other districts. The dynamo room, which is illustrated in the cut, is on the second floor. The present electrical equipment consists of three 60 light high tension and four 60 light low-tension Western Electric company's dynamos. Each machine is provided with an ammeter hung on the wall. The machines shown in front in the illustration, all belt down to a main shaft in the engine-room below. A 300-horse power Wright-Corliss engine drives the main shaft. The remaining two dynamos are driven directly by a 125-horse power automatic high-speed Buckeye engine.

The boiler room at the rear of the engine room contains six tubular boilers of the "complete combustion" type, built by the Portland company of Portland, Me.

The underground system from this plant is the same as that in use in the other districts. The cables were furnished and placed in position by the Cobb Vulcanite Wire company, of Wilmington, Del., and were guaranteed to have an insulation resistance of 500 megohms per mile after being placed in service, and also not to deteriorate materially for five years.



CHICAGO CITY ELECTRIC LIGHT PLANT, FOURTEENTH STREET AND INDIANA AVENUE.

Western Union Building, St. Louis, Mo.

The Western Union Telegraph company is fitting up elaborate headquarters at St. Louis. A little over a year ago the company's offices and operating rooms were destroyed by fire, and it was decided to select a new site for headquarters. The Lucas building on Pine street was chosen, and in August last the work of reconstruction was begun. The entire building was remodelled and the fourth story was raised several feet. A new roof, supported by iron trusses resting on iron pillars extending up from the foundation, was placed on the structure. The work on the building is nearly completed, at an expense of about $30,000. The work of putting in the steam and electrical machinery, running wires, and fitting up the interior is now in progress, and it is expected that the new quarters will be ready for occupancy early in the summer.

On the first floor will be located the receiving department, the office of the manager, and the accountants' and delivery departments. Pneumatic tubes will connect this floor with the operating department. The second floor will be divided into offices to be occupied by the executive officers of the second district, of which Col. L. C. Baker is superintendent. This district covers a very large territory, including nearly all of Missouri, Arkansas, Indian Territory and Texas, and portions of Illinois, Tennessee, Louisiana and Kansas. The Western Union time service will also have quarters on this floor. On the third floor will be the offices of the Western Associated Press, the stock reporting or "ticker" service, lunch room and dressing and toilet rooms. The "lamp room" is also on this floor. The cables carrying the conductors, about 300 in number, enter the building on this floor, at the northwest corner, whence they are carried along the ceiling to a point on the east side, and thence to the switchboard on the fourth floor.

The fourth floor contains a spacious room 40 by 127 feet, and 21 feet in height, surmounted by an arched roof, and will be occupied by the operating department. Two large skylights and numerous windows on all sides of the room admit abundant light and provide ventilation. About 260 tables will be placed in position. On the west side of the room will be the distributing table, where all telegrams are assorted and assigned to their appropriate wires, according to their destination, those received over the wires for St. Louis being dropped down the tubes to the delivery department. A feature of this room will be the switch-board, a highly ornamental structure of brass and cherry, 26 feet in length, occupying the center of the east side of the room, and providing accommodation for 250 main line wires and 200 multiplex local circuits. All wires from outside center here, and are thence distributed to the tables by loops. There are at present 161 main line wires, of which ten are worked on the duplex system, twenty-three on the quadruplex system, and two on the Wheatstone Automatic system, one extending from St. Louis to New York, and the other to Kansas City. These circuits are also worked duplex, the New York circuit averaging 100 words and the Kansas City 200 words per minute in each direction. The basement is floored with cement and extends the entire length of the building. This portion of the building is occupied by the steam and electric plant.

The steam plant comprises two boilers of 100 horse-power each, which will furnish steam for the engines, and also for heating the entire building. The engines comprise one of forty horse-power for driving the electric light machine, three of fifteen horse-power each for the electric generators, and two smaller engines, one for the elevator and one for the blower furnishing pressure for the pneumatic tubes used in the building and those extending to the branch office in the Merchants' Exchange building.

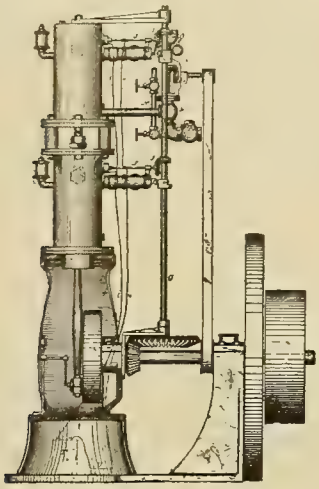
The electrical plant consists of fifteen generators, wound for an average potential of seventy volts each at a speed of 1,250 revolutions per minute; two generators of thirty volts each; two of five volts each, and a lighting machine, with a capacity of 450 incandescent lamps. The fifteen generators first mentioned will be in series of five each, two of which will be running continuously, while the third series will be in reserve for use in case of accident to either of the others. The ten generators in constant operation, each occupying a space less than two feet square, will take the place of about 12,000 cells of gravity battery now in use, and are capable of supplying double the number of wires at present used.

The electrical equipment was designed by Lee L. Summers of the Chicago office of the Western Union.

Hicks' Gas Electric Engine.

To electricians the most interesting feature of Hicks' new gas electric engine, illustrated in the accompanying cut, is the manner of firing the charges of explosive compound.

Gas is supplied to the engine from the pipe *N*, which connects to the air supply pipe *M*,



HICKS' GAS ELECTRIC ENGINE.

the explosive compound or mixture of air and gas being formed below the valve chamber *k*, of the governor *K*, which controls the amount of the compound admitted to the cylinders. From a battery *T* and coil *U* in the base of the engine extends a wire having branches which connect to contact points inside of each cylinder at its upper end, the points being properly insulated from the surrounding metal where it passes through the cylinder shell. Shafts *J*, connected by the wires *u* to the battery and coil, project into the upper end of each cylinder through suitable stuffing boxes, and are provided at their inner ends with toes or wipers, which, at each revolution of the shafts, strike contact points and cause electric sparks which fire the charge of explosive compound. These shafts are driven by the valve shaft *G*, through bevel gears *i*.

Base for Trolley Arms.

The features of the device illustrated herewith will be evident after an inspection of the accompanying cuts. At the base of the trolley

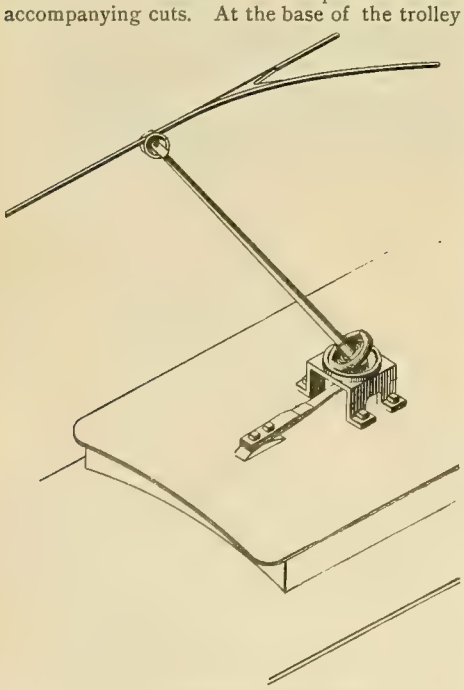


FIG. 1. BASE FOR TROLLEY ARMS.

arm there is a peculiarly shaped socket piece as shown.

The fulcrum-piece is made in the form of a disk having a rounded edge adapted to rock on a socket and is formed as indicated in the plan view to the left in Fig. 2.

The arrangement of the spring whether spiral or flat is clearly shown. Two of the features of the device upon which the inventor, Merle J. Wightman of Scranton, Pa., lays particular stress is the elliptical form of the socket and its position relative to the trolley wire. The advantage claimed is that the greatest pressure of the trolley against the wire, will be exerted when the trolley-pole is in a plane parallel to the wire. Where the overhead conductor is the most out of line the tendency of the wheel to leave the line will be the least.

Electric Safety Friction Clutch.

With the view of reducing the danger in the operation of belts and pulleys, and at the same time facilitating the manipulation of mechanical machinery, Siemens & Halske of Berlin, have developed a new electric friction clutch, illustrated in the accompanying cuts. This friction clutch serves the double object of transmitting power from the main shaft to the countershaft, and acts as a brake where a short stop of the countershaft is desired.

Referring to the illustrations, in Fig. 1 *W* is a main shaft on which is securely fastened a circular electro-magnet *E'*. Opposite this, but fastened to the hanger is another electro-magnet *E''* of the same size, and between these a loose pulley *A* is mounted upon the shaft with about one-half inch play to each side. The face of the electro-magnets and the inside of the pulley rim correspond conically to each other, so

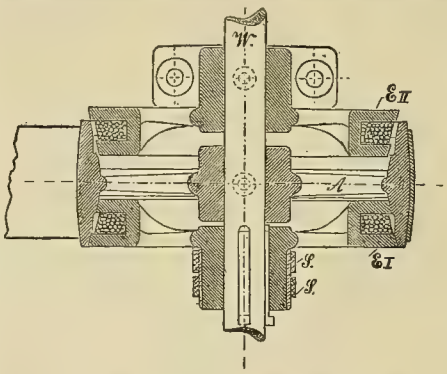


FIG. 1. ELECTRIC SAFETY FRICTION CLUTCH.

that when the pulley is moved it will be in good frictional contact with the corresponding clutch. For the transmission of the electric current to the windings of the moving electro-magnet or clutch *E*, the hub of this is furnished with two commutator rings *S S* mounted on insulated material, and forming the bearings for two brushes which are the terminals of the electric wires.

The function of the clutches now is easily understood. When the current is turned on the electro-magnet *E'*, the magnetism produced in the ring-shaped pole will draw the pulley into contact and take it along; if the current is switched over on the electro-magnet *E''* the pulley will be drawn up against this and stopped with the same power formerly employed in moving it. It is easily seen that the same arrangement can be utilized in any combination of transmission, that the pulley can be the moving part, and the countershaft the part to be moved.

The active iron in the magnets is utilized to its best advantage. Surrounding the windings on three sides, it gets the full benefit of the current, with the least possible weight of metal. The conical shape of the magnetic ring-pole and pulley rim will always secure a good magnetic and frictional contact. However, as the clutches necessarily are made of cast iron, the demagnetizing of the ring-poles by simply breaking the current is not easy, and the residual magnetism left in the cast iron ring will hold the pulley on the clutches. To overcome this Siemens & Halske have constructed a switch by which the current, in passing from one magnet to the other, reverses the current in the first, thereby changing the polarity in this, and actually throwing the pulley from one clutch to another.

This switch, as illustrated in Fig. 3, also serves as an automatic cut-out, a very important feature in protection of machinery.

A movable lever with two double contact arms is arranged to slide on two constant and four changeable contact points. A horizontal arm is furnished with a weight and a vertical arm catches on a trigger, forming part of the armature of a small electro-magnet. When the switch is in position, as shown in the cut, the current is passing through this magnet to the rotating clutch *E'*, and holding the lever in its

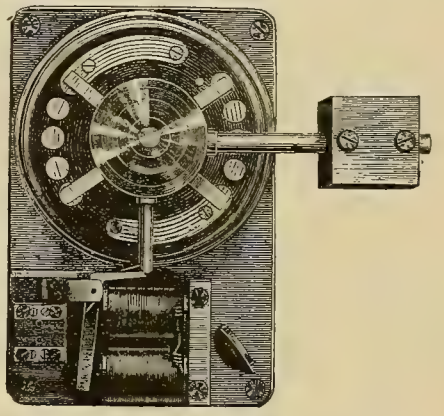


FIG. 3. ELECTRIC SAFETY FRICTION CLUTCH.

horizontal position. The moment the current is broken a spring throws the armature back, and releases the weight, which, in falling down, first changes the polarity of clutch *E'* and next throws the full current on clutch *E''*.

As the magnetic force of the clutches is in proportion to the ampere turns of the windings, the number of watts required for transmitting a certain amount of horse power is easily determined. In the new factory of Siemens & Halske at Charlottenburg, near Berlin, where the system has been used continually for more than a year, fifty electric safety clutches, each transmitting six horse power, require only a total electrical energy of 2,200 watts, equal to about three-horse power or one per cent. of the total power transmitted.

The windings of the magnets can be made to correspond with any voltage, and have been tried both for 110-volt current taken directly from the electric light wires, and on a fifty-volt current from a separate generator. The latter plan seems to be preferable. The generator is then driven direct from the engine, and whenever this is stopped the current ceases, and each au-

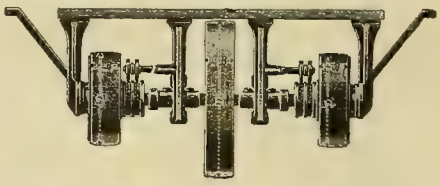


FIG. 2. ELICTRIC SAFETY FRICTION CLUTCH.

tomatic switch throws its individual machine out of coupling with the main shaft. The illustrations are taken from the *Electrotechnische Zeitschrift*.

Lieut. Frank J. Sprague's Career.

Writing of Frank J. Sprague, Edith Sessions Tupper, the New York correspondent, says: "The career of F. J. Sprague is full of romance and interest. It was not so many years ago that he was a subordinate in the navy with no money and little prospect of promotion. But he was an

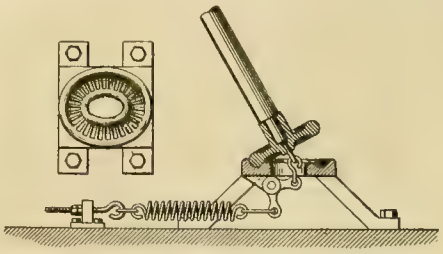


FIG. 2. BASE FOR TROLLEY ARMS.

enthusiast on the subject of electrical experiments. In 1882 he was detailed to report on the first electrical exhibition held at the Crystal Palace in London. He drew up so remarkable a report that it at once gave him an international reputation. He then decided to devote his life to the perfection and development of electric power. He at once resigned from the navy and began bringing out various forms of electric motors, and soon inaugurated an enormous industry, which speedily brought him fame and money. Then Mr. Sprague began to investigate the possibilities of the electric motor for street railways, with what result all the world knows. Mr. Sprague is a slim, aristocratic looking man, possessing a sweet smile and a wonderfully pretty wife. He is a prominent figure about town and at public assemblies."

Mammoth Dynamos for Central Station Work at Paris.

The accompanying illustrations represent a type of dynamos recently introduced for central station work at Paris. The most striking feature is the immense size of the armature, which it is claimed, exceeds anything heretofore constructed for continuous currents.

In the central station at Rue des Dames, at Batignolles, there are three Corliss engines of 600-horse power each. These are connected directly to three large dynamos. The engines make sixty-five revolutions per minute, and the output of each dynamo is 700 amperes at 500-volts or 350-kilo watts. The armature is of the Gramme ring-type, and is ten feet eight inches in diameter, with twenty-two inch face. The core is made of laminated soft sheet iron, and is mounted on a star-shaped frame having thirty branches of cast bronze. The field magnets are placed inside of the ring, and there are eight poles, alternatingly positive and negative. The total weight of this monster armature is eight tons. In the winding there are over 2,000 turns. Square copper wire or bars are used. The outside layer, being naked, serves as the commutator. Eight sets of brushes, one for each of the eight magnetic poles, collect the current. They are joined in multiple, forming the poles of the dynamo. As the speed of the periphery of the armature is 39.6 feet per second, the pressure of the brushes against the commutator must be very light. A light touch of the brushes is obtained by mounting them on brass springs of great elasticity. These brushes may be shifted along the commutator, thus reducing the wear on the armature to a minimum. The brushes are supported by a separate frame centrally mounted on the bearing of the dynamo and can be adjusted by a combined lever and gearing.

In the illustrations, Fig. 1 represents an armature in process of construction, and Fig. 2 shows the building of the armature core. The general features of the combined engine and dynamo are illustrated in Fig. 3. This dynamo, however, is of less capacity than the others, the output being only 160-kilo watts, and is it intended for smaller stations.

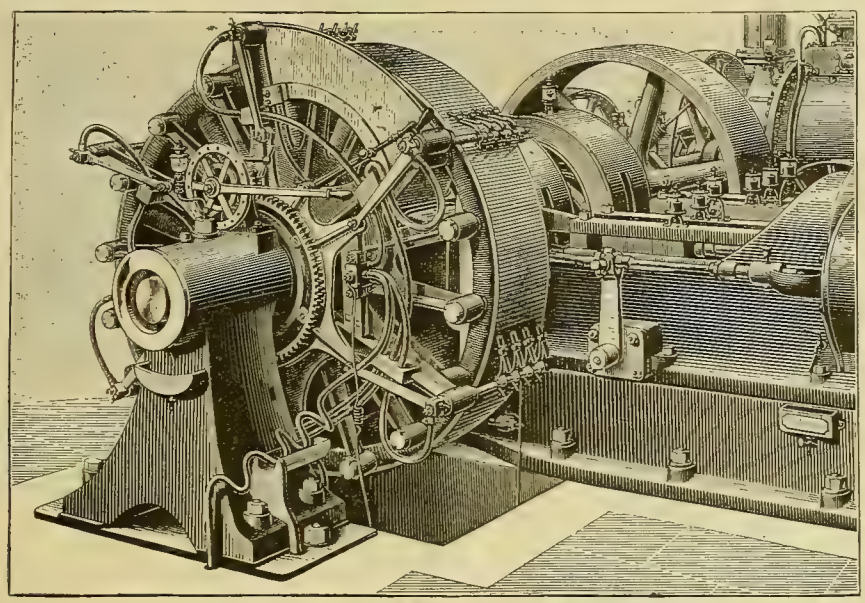


FIG. 3. MAMMOTH DYNAMOS FOR CENTRAL STATION WORK AT PARIS.

The three dynamos of the station at Rue des Dames, at Batignolles, are connected in multiple through a set of heavy buss bars. The difference of potential between the buss bars is from 450 to 500 volts, and the distribution is through a four or five wire system. It is possible to deliver the current to the consumer at nearly any voltage desirable. The leading wires are all distributed through the extensive sewer system, which serves as the main subway conduit of Paris.

It is the intention of the company to develop the motor business, introducing small machines in the workshops of Paris. The experience gained in the operation of this station will undoubtedly lead to further extensions in the same line. The cuts are reproduced from *La Nature.*

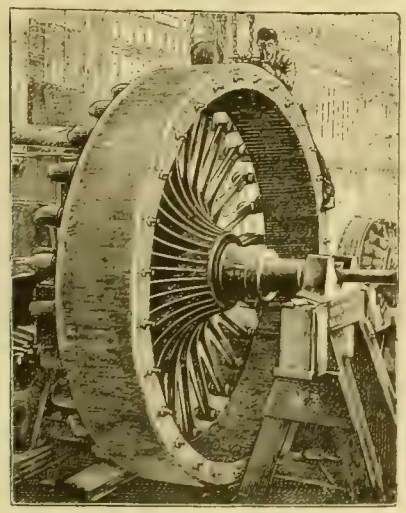


FIG. 1. MAMMOTH DYNAMOS FOR CENTRAL STATION WORK AT PARIS.

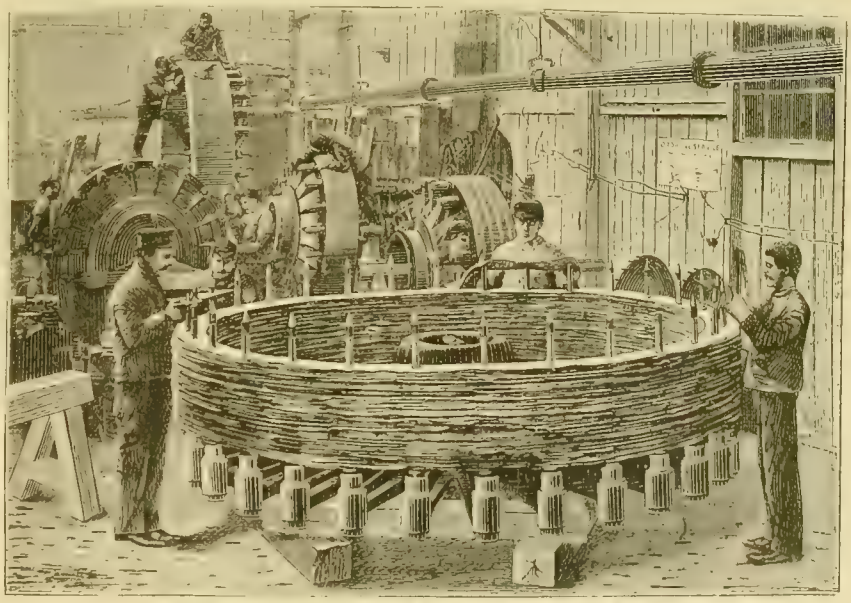


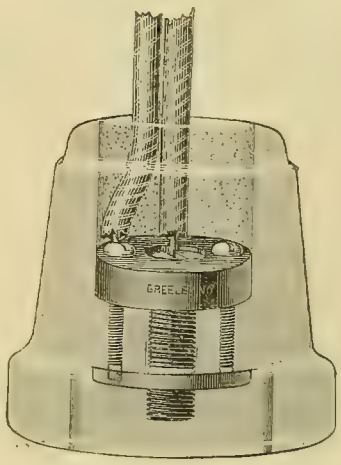
FIG. 2. MAMMOTH DYNAMOS FOR CENTRAL STATION WORK AT PARIS.

Atlantic and Western Telephone Company.

The Atlantic and Western Telephone company has been incorporated with a capital stock of $5,000,000. The incorporators are H. C. Caldwell, H. C. Strong, E. B. Springer, G. J. M. Porter and G. M. Brinkerhoff. Mr. Caldwell says that the company will manufacture telephone apparatus under the Strong patents, but will not operate lines. It is probable that Chicago will be the headquarters of the company, should it establish a factory, as four of the incorporators are Chicago merchants. The Bell company may attempt to interfere with the plans of the new company.

Cartwright Waterproof Socket.

A new waterproof socket, introduced by the E. S. Greely & Co., is herewith illustrated. It is known as the Cartwright waterproof socket. It is claimed for the device that the porcelain itself, which forms the shell of the socket, is a thoroughly vitrified substance. The metal parts are fastened to the porcelain frame and do not depend for their security upon the sealing compound. The sealing compound itself is of a quality that will stand a zero temperature without deterioration and at the same time will admit of the heat that results from a 3 ampere lamp without softening, although the device is designed simply to meet the requirements of lamps from ½ to 1 ampere capacity.



CARTWRIGHT WATERPROOF SOCKET.

The Cartwright Waterproof Socket is made in three patterns to accommodate lamps of the Edison, Thomson-Houston and Westinghouse types. They are made, as shown in the illustration, with rubber insulated terminal wires projecting several inches from the shell to admit of rod connections.

The Next Electric Light Convention.

The Canadian newspapers are jubilant over the fact that the next convention of the National Electric Light association will be held in Montreal. The *Star* of that city says: "It is the intention to make this convention of unusual interest, and over 500 members will be present. The exhibition of electrical appliances and machinery will be one of the most interesting ever seen, and it is hoped that the Customs department will give every facility to the association in bringing their exhibits here."

Direct Resistance Measurements of Accumulators and Arc Lights.

The accompanying cuts illustrate the methods employed at the Electro-technical Experimental station of Munich, Bavaria, to measure the resistance of accumulators during charging and discharging, and also the resistance of arc lights.

Fig. 1 illustrates a test during the process of charging an accumulator. The principle of this method is simply that of the Wheatstone

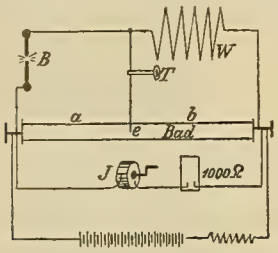


FIG. 4. DIRECT RESISTANCE MEASUREMENTS OF ACCUMULATORS AND ARC LIGHTS.

bridge. *A* is an accumulator of 13 plates, each 10½ x 7¾ inches. The distance between the plates is ¼ inch, and the accumulator is of very low internal resistance. *W* is a permanent resistance estimated to have about the same resistance as *A*, or, in this case, about 0.0033 ohm; *d* is a test wire of nickeline, 3 feet long and having a sectional area of .986 circular mils. *D* is a small dynamo of 4 volts with 2,500 revolutions. *T* is a telephone taking the place of the galvanometer in the bridge.

The pulsative current in this dynamo caused by the limited number of segments of the commutator produces a very distinct humming in the telephone. As the resistance to be measured is very small, reliable contacts must be provided, so the contact points 1, 2, 3, 4 are connected to mercury cups. One of the telephone cords has a tip for changing from one contact cup to another. The other telephone cord is mounted on the test wire by a sliding contact. By moving this contact, points on the test wire are found at which the humming of the telephone is weakest, corresponding to the four points 1, 2, 3, 4. These points are readily determined, as the tone of the sound changes suddenly and very remarkably in passing the point. The four points divide the test wire into five sections, the resistance of each of which will correspond to the resistance of, 1st, leading wire to the accumulator; 2nd, the accumulator itself; 3rd, the leading wire between the accumulator and the resistance *W*; 4th, resistance *W*, and 5th, the leading wire from *W*. The resistance of the accumulator *A* can now be easily found by a single equation.

In testing by this method, even with heavy currents, there is little or no difficulty, as the loss of current through the test wire points 1 to 4 only amounts to about 1-200 part of the total current.

For the purpose of testing during the process

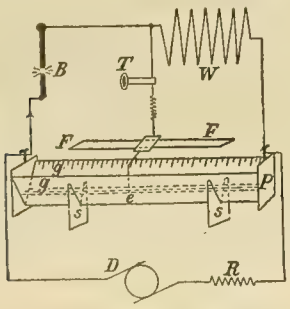


FIG. 3. DIRECT RESISTANCE MEASUREMENTS OF ACCUMULATORS AND ARC LIGHTS.

of discharging, a similar arrangement is made: *A*, Fig. 2, is the accumulator fully charged, *W* is a permanent resistance, in this case 0.007 ohm, *d* is a test wire of german silver with an area of 3,550 circular mils, having a resistance of 0.12 ohm and capable of carrying the full discharging current. As a shunt on the test-wire an interupter, *J*, is joined. When this is rotated quickly the breaking and closing of this line will respond in the telephone. To avoid too much variation in the discharging current a resistance of 2 ohms is cut in on the street wire, reducing the variation in the main line to a minimum, still, however leaving enough to be recognized in the telephone. Direct measurements showed the amount of current in the main line to be 17 amperes against 2 amperes in the shunt line. The test is made in the same way as by the charging process. Four points on the test wire are found and the internal resistance of the accumulator determined by its proportion in the equation of three known and one unknown resistances. The test wire *d* can become considerably heated without any serious effect on the sliding contact *K*, Fig. 2.

In testing arc lights with dynamo current, the same principles can be utilized, as the pulsations of the dynamo current furnishes means to determine the neutral point in the Wheatstone bridge. In this case, however, where a current of high e. m. f. is being handled, it is necessary to have the test wire in a different shape and of a very high resistance. Fig. 3 gives a novel and practical arrangement for this experiment, *B* is the arc to be measured, *W* is a nickeline resistance without self-induction, *T* is the telephone, *D* is a dynamo with the adjustable resistance *R*, *TT* is a V shaped tray of glass with wooden end pieces, *P*, securely tightened and furnished with copper pole-connectors, *ss* are wooded supports. One side of the glass tray carries a scale and is partly filled with a solution of sulphate of copper. The total length is 15½ inches and the resistance from 1000 to 4000 ohms, in accordance with the amount of solution poured in the tray. One side of the telephone is connected between *B* and *W*, the other side, which must terminate in a copper wire or plate, is projecting into the solution and,

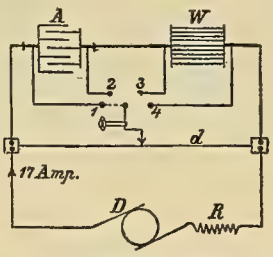


FIG. 1. DIRECT RESISTANCE MEASUREMENTS OF ACCUMULATORS AND ARC LIGHTS.

for obtaining an easy adjustment, it is connected to a slide on a guide *FF*. The proceeding now is practically the same as before: *e* is moved until the point is found where the sound in the telephone is weakest and the tone changes. This point divides the tray in two parts, and the value of these, together with that of *B* and *W*, form the equation out of which the resistance of *B* is found.

In testing arc lights fed by accumulators the process is the same except that the current interrupter *J* is shunted on the line together with a proportionately high permanent resistance. The object of this is to produce a vibratory sound in the telephone. In this case, like in testing with dynamo currents, only one point in the tray is determined, as the resistance of the leading wires is too small to be taken into consideration. Having divided the tray into two parts, *a* and *b*, Fig. 4, the resistence of *B* is found to be

$$\frac{w + a}{b}$$

The results obtained by accumulators were in every respect the same as for dynamo currents.

The cuts are reproduced from *Electrotechnische Zeitschrift.*

Telephone Rates in New York.

The New York legislature is considering a bill providing for a reduction of the price of telephone service in cities over half a million inhabitants. Of course the bill is aimed at the Metropolitan company of New York City. It provides that telephone companies must furnish service to all persons within their districts applying for the same in cities of more than 500,000 inhabitants at the rate of $75 per year. A higher price may be charged where an exclusive wire is furnished. The friends of the measure say that a $75 rate will yield a liberal dividend on the capital invested in the Metropolitan Telephone company. They say that single subscribers in some parts of the city are refused instruments and service, even at existing rates, on account of the trouble and expense of connecting them. The cash capital of the Metropolitan company, they say, is but $500,000, while six or seven per cent. dividends are paid on a watered capital of $2,000,000. In addition, the company has paid out of its earnings $500,000 to $800,000 for its Cortlandt street building, $150,000 to $200,000 for its Thirty-

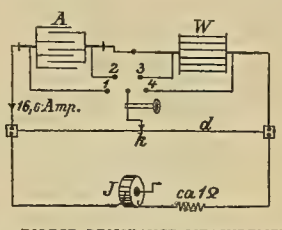


FIG. 2. DIRECT RESISTANCE MEASUREMENTS OF ACCUMULATORS AND ARC LIGHTS.

sixth street building, $150,000 to $200,000 for its Harlem building, and $400,000 for its big new switch-board.

The company contends that it cannot furnish the service at a $75 rate, and that if the bill is forced the improvements now under way and contemplated must necessarily be discontinued. It is expected that the assembly committee will report favorably on the bill.

Underground Work in St. Louis.

The committees on Street Department and City Lighting of the Board of Public Improvements, St. Louis, held a meeting last week to consider the plans of the St. Louis Underground Service company. Representatives of the company submitted a profile of the proposed conduit

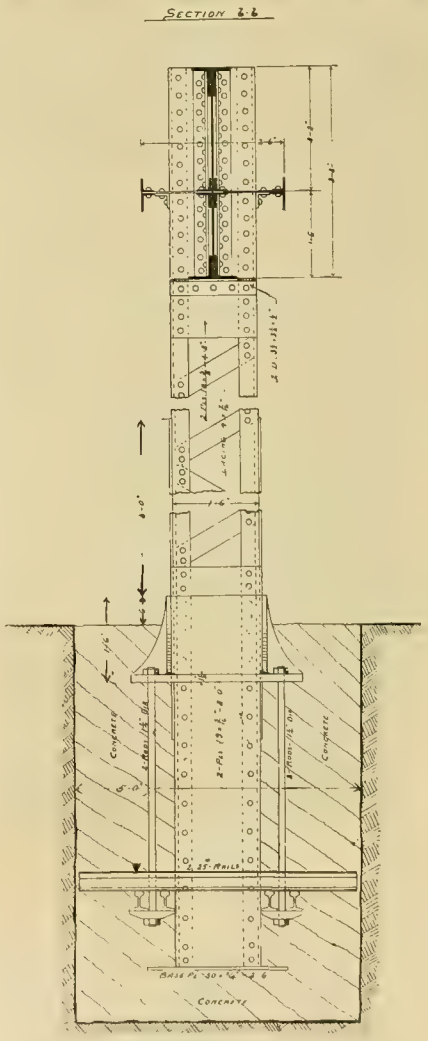


FIG. 4. ADAMS' ELEVATED ELECTRIC RAILWAY.

under Olive street from Fourth to Seventeenth street, which the committee took under advisement. The plans are considered good if they can be put into operation without disturbing the sewer, water and gas pipes with which some of the streets are pretty well filled.

Adams' Elevated Electric Railway.

One of the plans proposed for the transportation of passengers on the World's Fair grounds, which is reported to have received the favorable consideration of the directors, is the

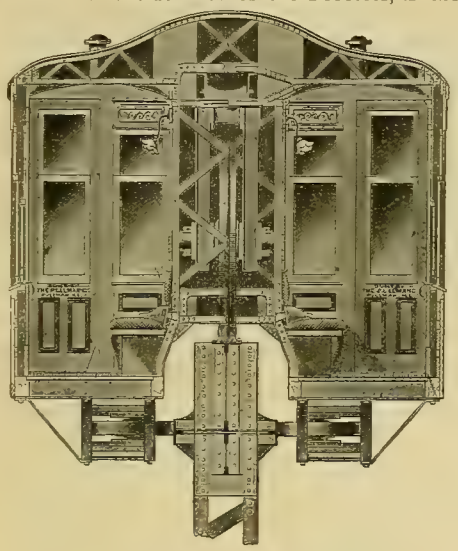


FIG. 1. ADAMS' ELEVATED ELECTRIC RAILWAY.

Adams' Elevated Electric Railway system, some of the features of which are herewith illustrated.

As its name implies, this is an elevated railroad, operated by electricity. It is proposed to oporate fifty-two single cars on a three-mile loop at Jackson Park, the average speed being twelve and one-half miles an hour. The number of stations has not been determined as yet and will, of course, be influenced by the location of the buildings and objects of interest. The three distinctive features of this system are a single track, one line of iron posts supporting the superstructure, and the large paper driving wheels, four feet and six inches in diameter inside the car.

The interior construction of the car is shown in the sectional view given in Fig. 1. The motive power is applied to the rear driving wheel by a fifty horse-power, double field motor, having two armatures and geared by beveled pinions directly to the wheel. The trolley wire is underneath the car. The large wheels are held in position by smaller pilot wheels, each pair being encased in a solid truck. The rail, shown in Fig. 2, is made with a slot to receive the flange of the supporting wheels. It is inside of, and considerably above, the floor of the car. Below the car and attached to it are four horizontal guide wheels shown in Fig. 1, two on each side, moving along and against a vertical face, to insure steady motion and secure additional stability.

In Fig. 3 the superstructure and substructure are shown. Each column, Fig. 4, supporting the superstructure will be fifteen by eighteen inches, and the distance from the ground to the bottom of the overhead construction will be fourteen feet six inches. The columns will be set in eight feet of concrete and will be located forty feet apart. The girders forming the superstructure will be three feet eight inches high and two feet six inches wide. A reference to the cuts will show the method of construction.

It is claimed for this system that cars can be operated at the rate of twenty-five or thirty miles an hour with perfect safety. But little obstruction to surface traffic is presented and hardly any light or air shut off from the street on which it is operated. Each car is designed to carry thirty passengers, and it is asserted

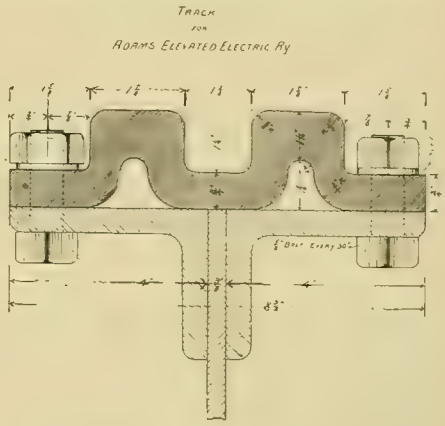


FIG. 2. ADAMS' ELEVATED ELECTRIC RAILWAY.

that, if necessary, the cars can be run at intervals of twenty seconds apart, thus providing adequate means for meeting the demands of heavy traffic. The system is purely of Chicago origin, and the inventor is J. W. Adams.

Frank B. Rae, of the Detroit Electrical Works, is consulting electrical engineer of the new system.

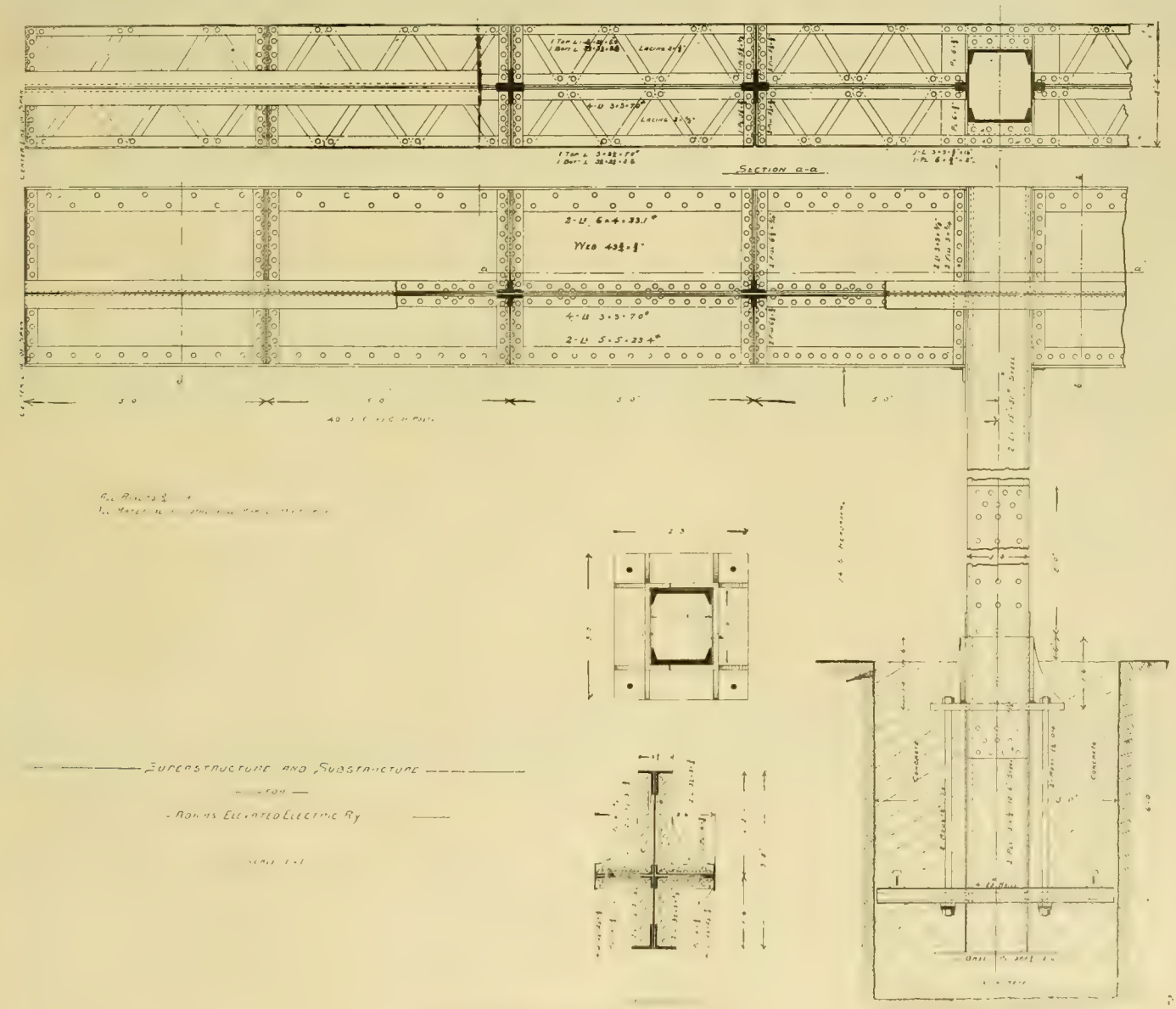


FIG. 3. ADAMS' ELEVATED ELECTRIC RAILWAY.

The people of Brownwood, Tex., are talking of putting in electric lights.

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F. L. PERRY, - - - - - - - - - - }
W. E. KEILY, - - - - - - - - - - }
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Now that the electrical department of the World's Fair has an office of its own at the exposition headquarters, the vast amount of work before Prof. Barrett and his assistants will be entered upon in earnest. Already the electrical fraternity of this country has given unmistakable evidence that the electrical display will not only be the finest ever made in the world's history, but it will take position as the most attractive feature of the great exposition. And it will not be long before the electricians of other nations will join in the general desire to make such a showing of the applications of electricity as will make a lasting impression on all visitors.

THE report of the discussion of Mr. Crosby's paper before the American Institute will be read with interest by all who are engaged in railway work. The discussion developed into a general talk on electric railway construction and the comparative merits of electric and steam roads. One gentleman recalled the statement made by Franklin L. Pope that electric railway men were not only willing to encounter grades of 7 and 8 per cent. but also grades at the end of every rail. Much useful data is found in the discussion, which is reported in full elsewhere. It seemed to be generally conceded that the standard of street railway work was improving.

THE Metropolitan Telephone company, of New York, has been attacked in the legislature, a bill providing for a $75 rate being introduced in that body. The company claims it cannot give the service required for $75, and that if the bill should pass, the improvements in the system would necessarily cease. On the other hand the advocates of the bill claim that the telephone companies at present are engaged in fortifying themselves in anticipation of the expiration of the original Bell patents. They are expending large sums of money improving their plants, introducing the latest devices and most improved methods, and extending their service in every direction. Subscribers will reap the benefits of these improvements, as the service will be far superior when the changes are made. The companies, too, will be in a better position to successfully compete with rivals that will spring up as soon as the original patents expire. If they succeed in raising the standard of their service and extending their system, it will naturally be harder for new concerns to secure a foothold.

THE tunnel accident in New York recently forced upon the public the consideration of the question of providing a reliable system of tunnel signalling. Many excellent suggestions have been made and one of them is presented in this issue. It is proposed to establish a line of incandescent lamps through the tunnel two feet from the engineer's cab window and two hundred feet apart. These are to be operated in connection with and as an auxilliary of the block system now in use and not as a substitute —it is merely an additional precaution. The method is explained and illustrated in another column. Railroad officials generally are opposed to any system in which colored lights are to be employed, as the different colors would only tend to confuse the engineer. It has been suggested that the companies operating lines through tunnels illuminate these passages by electricity—that they flood the interior with an evenly distributed light which shall enable the engineer to see as well as if he were on the open plain. Of course this could be done but only at a great expense and other means besides persuasion would be required to get the railroad companies to accept such a plan. There is no doubt that some method of guarding against a repetition of the tunnel horror of New York will be secured in response to the general public demand. The railroad companies themselves cannot afford to disregard the public clamor against the present arrangement.

AN interesting incident in the controversy between the electric lighting companies of New York city and Mayor Grant is reported by the New York daily papers. It appears that during the last meeting of the Board of Electrical Control when the question of burying the wires of the Postal company was under consideration, the mayor asked why they had not already been disposed of. He was informed that the company had been enjoined from making any change in its system, and that pending the disposition of several legal questions, nothing could be done. Thereupon, the mayor expressed his displeasure and his disregard for the rights of others, as well as his disrespect for legal forms of procedure. The *Sun* quotes him as saying: "I don't care anything about law points," and the *World* report contains substantially the same statement: "What law points? I don't care for law." This is in keeping with the petty spirit displayed by Mayor Grant throughout his reckless crusade against the interests of the electric companies. It is certainly humiliating to New Yorkers to see their chief executive officer display his temper in public. Even the New York papers do not uphold him in the position he has taken. The *World* cautions the mayor to exercise a little judgment rather than display his wrath, and continues: "The companies ought to have applied for conduits before the streets were repaved, but there are other than corporate interests to be consulted. The people who use the wires should not be deprived of them. It is probable that the board can bury the wires in a quiet and dignified way, without indulging in any destruction, if it sets about the task in earnest."

THE question of securing rapid transit between the center of the city of Chicago and Jackson park and a complete system of transportation about the grounds during the World's fair is one of the most important problems that will confront the management of the great exposition. Many electrical engineers have no doubt given this subject much attention although they have received little encouragement or reason to believe that their suggestions or plans would be considered. It has been assumed by many that elevated roads and steam locomotives would be used, but it is by no means impossible that the whole problem will be solved by the electrical engineer. In the last issue of the WESTERN ELECTRICIAN attention was called to the fact that much time was being wasted if it was proposed to present the features of electric railways on an elaborate scale at the exposition. The marvelous development of this department should not be neglected and there is every reason to hope that those interested in the promotion of electric railways will take the matter up seriously and exert themselves. Already there are signs of awakening interest. In this issue is presented a description accompanied by drawings showing special features of a proposed system of elevated roads in which electricity will be used as a motive power. There are many novel features which will prove highly interesting. No doubt other plans will be presented and it is to be hoped that an electric system will finally be adopted by the fair authorities.

THE Rochester, N. Y., *Herald*, after quoting the complimentary notice regarding the construction of the overhead wires in Rochester, which we published last week, adds: "We judge that the Rochester company compares very favorably with that of any other city, and we cheerfully indorse what is said about the value of first-class construction in any direction. But we cannot agree with the WESTERN ELECTRICIAN that 'there is no reason why the electric lighting companies in cities the size of Rochester should be compelled to go underground'—with their wires, we suppose. Rochester is not as large as Chicago, but its business thoroughfares are just as busy as Chicago's, and in these the countless wires of the various electric companies are a perpetual nuisance and often a source of great peril, especially when large fires are in progress."

Rochester is a beautiful city; its people are enterprising and progressive; it has many fine institutions and business interests; but its streets are not as busy as Chicago's, and the residents of the Flower City are, no doubt, thankful they are not. We reiterate the statement, and we believe that the most earnest advocates of underground service will support us, that it is the height of folly for cities no larger than Rochester or Buffalo to insist upon electric companies burying their wires. Prof. Barrett, than whom there is no more earnest opponent of overhead wires in large cities, has always made this distinction. He recognizes the fact that to impose such conditions on electric companies in smaller cities would, at the present time, practically prohibit them from operating their systems, as it would be impossible to secure rates that would warrant them in making such an expenditure. Electric companies will not operate their plants at a loss, and that is what they would have to do if they undertook to go underground in the smaller cities at the present rates.

Report of High Speed Electric Railway Work.

At the conclusion of O. T. Crosby's interesting paper before the American Institute of Electrical Engineers, entitled "Report of High Speed Electric Railway Work," published in the last number of the WESTERN ELECTRICIAN, the following discussion took place:

W. H. PEIRCE: I would like to ask Mr. Crosby if he has made any calculations or estimates as to how far and how long the train would run before it would attain a speed of 150 miles, and how far it would have to run before you can stop it.

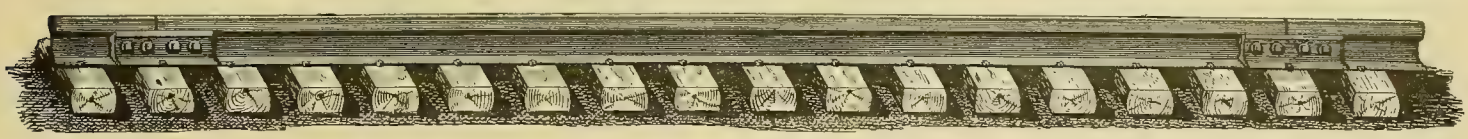

FIG. 1.

MR. CROSBY: I did make calculations as to the attainment of speed, and the matter of stopping it I expressed in the paper. I knew that those figures could not remain in the minds of those hearing the paper. The space for stopping, with a braking power that would just fail to slide the wheels would be about 7000 feet and the time would be in the neighborhood of 100 seconds. The time of getting the train to speed, with the motors as designed, I have forgotten now, but it is in the neighborhood, I think, of 2 or 3 miles.

MR. PEIRCE: In getting an ordinary train to speed at 60 miles it will take over 3 miles, and I should think it would take ten or twelve to get it to a speed of 150.

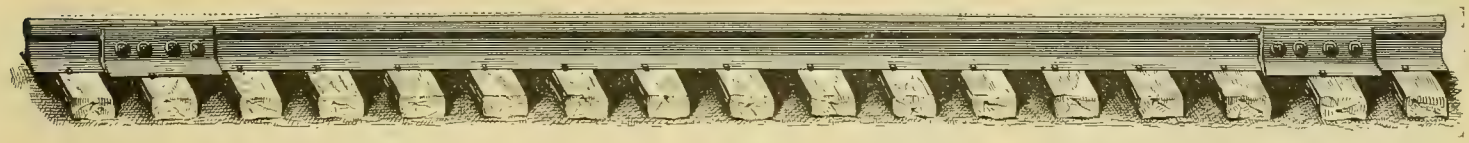

FIG. 2.

MR. CROSBY: It may have been more than 3 or 4 miles, but I think they would attain that speed with the lighter weight they have to handle, and the power proportioned to the weight, in 6 miles.

MR. PEIRCE: The only reason I bring this up, is, that in running these trains a short distance it would not be possible to attain very high speed.

MR. CROSBY: I should say that I do not think there is anything whatever in high speed work for, say, even 40 miles. I do not think you can properly do 120 miles an hour for a run of 30 or 40 miles. It is applicable only to connecting very large cities. I think you could run from here to Albany if you had the New York Central line

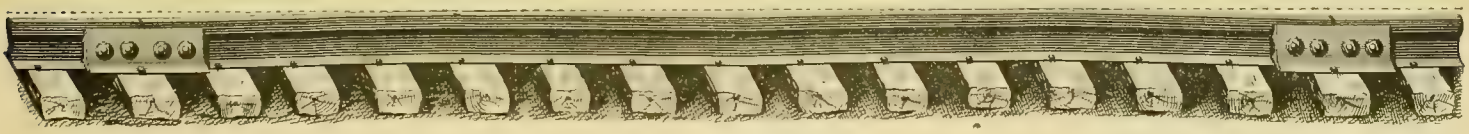

FIG. 3

to run on; from Albany to Rochester; from Rochester to Buffalo, and then stopping at the principal lake cities. It might be found later on that it would be necessary to make shorter stops, but the first efforts should be made only with very long runs.

F. L. POPE: In conversation some time ago with a prominent civil engineer, at one time professionally connected with the Lake Shore road, he expressed the opinion that safety from derailment at very high speeds would be best secured by very slightly curving the line of the road, just sufficient to cause the flanges of the wheel to bear constantly against one side. With that construction he should expect that any possible speed, up to say 200 miles an hour, that could be got from the motors, would be perfectly safe.

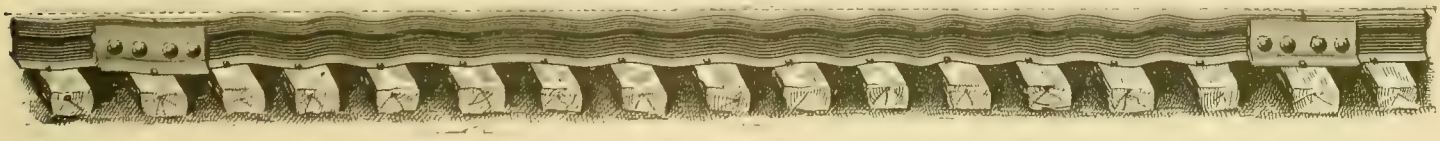

FIG. 4

He was led to this conclusion from long observation of the performances on the Lake Shore road of railroad wheels at high speed, where, as many of you are aware, some of the best running in this country has been done.

THOS. D. LOCKWOOD: I should like to add one or two remarks with regard to what Mr. Crosby has just now said—that he does not consider high speed, extremely high speed, or even so low speed as forty miles an hour to be a very important factor except for extremely long runs. I do not know whether I correctly understood that?

MR. CROSBY: What I meant to say, was, that I did not think a speed of 120 miles an hour was commercially applicable to short runs of say 40 miles. Suppose we have to stop 40 miles away from New York, I do not think it would pay even for a good sized city to establish a service there, aiming at a speed of 120 miles for a very short distance: You would no more than obtain it when you would have to give it up.

MR. LOCKWOOD: I have worked in various capacities upon railroads, and I have had some experience upon steam locomotives, and such experience as I have had leads me to this statement—that the best speed I have ever known to be made out of an average of a great many trips has been done by way trains where the stations were very close together; and the reason of that is, that upon a long run you can obtain a fairly high average without even getting an immensely high speed; whereas upon way trains, where the stations are very frequent we often have to run at enormously high speed between stations to maintain the time and that is often when we have runs of only two miles between stops. There is a road I have in mind in the western part of Massachusetts and Connecticut on which I have worked—the Housatonic railroad—and between Pittsfield, Mass. and Canaan, Conn. There are a large number of stations. I have known trains to leave Pittsfield some 50 or 60 minutes behind time, and reach their destination on time. Now that sounds rather fabulous to gentlemen who have not been on locomotives or who have not run locomotives. I heard statements made at meetings of this association some time ago, in which Mr. Rice took part, to the effect that a great part of the power saved while running down grade might be used to operate dynamos for lighting purposes. Now the experience of all locomotive engineers leads them to the conclusion—whatever it may lead other persons to believe—that they want all the power all the time, and they are very glad indeed to get a chance to run down grade once in a while.

I noticed that Mr. Crosby in his paper made no reference to what some eighteen months ago was a very prominent issue, namely, the improvement of adhesion by the passing of a current from the wheels to the rails. I recollect in different meetings, social, legislative, and litigative, in which I have had the honor to appear both as a spectator and participant, that that issue was made particularly prominent. Some electricians ascribed it to magnetism, which in some occult way escaped from the motor and reached the wheels and from there passed to the rail. I believe that magnetism is going to be one of the great breaking powers of the future, but I do not believe it is going to reach the rails that way. I see that Mr. Crosby has advanced from the opinion which was, to say the least, popular for a few years. In prior meetings of this institute, Leo Daft and others have made statements—I do not know whether they were deliberately written on paper or made on the spur of the moment in discussion—very strongly assuming that there was such a useful effect; Mr. Ries also was a very prominent advocate of that alleged method of improving adhesion. I do not think there can be any doubt that when heavy currents pass from wheel to rail or between any metallic contacts there is a certain slight adhesive effect. I do not think it has any practical effect upon the adhesion which a train in practice requires. In 1878 that very eminent mechanician, Mr. Stroh, in London, ascertained that in passing even comparatively feeble battery currents between contacts that there was a very decided adhesive effect upon a small scale; and he tried this with a geat number of metals and alloys, finding that steel—two contacts of steel—gave the very best effect, as compared with other metals. In the light of what we know now it is very clear that it was a welding effect; that even small currents in passing through loose contacts developed enough heat to make a weld. Mr. Stroh used a lever with a weight upon one end, and in some of the experiments the lever had an equally long arm at the other end, and after passing the battery current through those loose contacts and after placing a weight thereon it was found that that equal weight would not separate the contacts again. But I am compelled to say from my own practice that I do not believe that such an adhesive effect as may exist has any practical utility; for this reason, among others, that such power as it does exert in holding the wheel on the track is lost by the equally certain fact that it must certainly require as much force to unweld it again so as to admit of the progress of the train.

MR. CROSBY: I may answer that I did not mention the fact in the paper.

MR. LOCKWOOD: I know you did not, and I wished to ask you, whether you had any decided opinion.

MR. CROSBY: Very decided indeed. I do not think there is anything in it at all. I have put myself on record as thinking there is nothing in it—short of such currents as will actually heat to welding. I know of experiments which were never published, but which were made by a man much interested in the subject at one of the great universities of the country which indicate that in a three or four pound model it took something like two hundred amperes to produce any effect, and that was plainly a welding effect, since it showed a clear pitting of the little rail on which this model used to run. Now the number of amperes used there—certainly one hundred—was surely out of proportion to the current that is used at any time for transportation. That perhaps is like the answer of the mayor, who said he did not have any cannon, and therefore did not salute his majesty—that was one of his ten reasons. In this work here described there cannot be, in my opinion, any such grade work attempted as to make necessary a distinction from that of ordinary coefficients, even if it should be obtained by the use of extravagantly high currents. I do not know what would be the biggest grade. It is simply a question of how much you are willing to sacrifice in speed in order to save original expense in constructing your line. It is the same question that is presented to the steam railway engineer. He cuts between the two extremes. I should say roughly now that perhaps a two per cent. grade would be a pretty heavy grade to contemplate for that work on account of the great tax on the motors, and the actual requirement of power. Then in the matter of the breaking effect I do not know whether Mr. Lockwood meant the return of power from the dynamos as the breaking effect which he thought would be useful, or not.

MR. LOCKWOOD: No; I meant the idea of short-circuiting. Such a scheme was patented within the last ten years. I do not believe it has ever been used.

MR. CROSBY: I did not consider the matter of return of energy to the line, because, as Mr. Lockwood says, they want all the power they can get, and because the number of stops is very small compared with the number of miles run. It might be different, say on the elevated railway service. It might do to run your motors as dynamos, and let them give back the work of retardation into the line. But you make a little sacrifice to do that. That is, you have got to work your motors at lower than saturation point for your normal work. Otherwise I do not see how you can get the electromotive force of the motor high enough to pump back into the line. For that reason I do not think it has any place in long distance work where your stops are one in a hundred miles.

MR. PEIRCE: I would like to ask Mr. Crosby, in working the size of wire out for the most economical conductor, how much variation of the electromotive force he found in the line from the terminals to the center.

MR. CROSBY: I did not use the ordinary equation for determining what would be the most economical drop on the line. I simply took almost at random, as I was very much pressed to get this into shape, thirty-three per cent. drop on the line, and had done so all along, thinking that it would be practicable to have that, although I do not know that it would be the most economical drop.

MR. PEIRCE: I meant the variation, you know. I did

not mean the total drop. I meant the variation between different points of the line.

MR. CROSBY: That is connected with the amount of drop. If you had thirty-three per cent. drop that would give you an inference at once as to all the variations there would be on the line.

MR. PEIRCE: I did not know but what you would run out feeders so that you would have only four or five per cent. variation at different points of the line.

MR. CROSBY: That might be desirable, but I think it would be just as well to put your whole motor in once for all instead of whittling down. Thirty-three per cent. was at the farthest point to which any station would supply the current.

EDWARD P. THOMPSON: I would like to ask if it is your opinion, based upon your experiments, that it is impracticable to run an automatic electric train for the purpose of carrying mail matter and other objects of great value where it is necessary to have high speed? It is even of more importance, it seems to me, to transport such from here to Philadelphia, Chicago and other distant places at a great rate than it is to transport people. A great many of those high-speed passenger trains were reduced in speed because it was found that people really did not care to go so fast, and because of the wear and tear on the locomotive machinery; and therefore the high-speed trains running at over sixty miles per hour were to a great extent taken off, both in England and the United States, as fully stated about a year ago in the reports of several railway companies; but if, in practice, they actually could get a speed of 120 or 150 miles per hour, it would be more acceptable, I think, for small express packages and mail than it would be for passengers.

As regards brakes for stopping high-speed trains, the principal point is economy. I found in some tests made by me in behalf of a brake company upon a railway in Pennsylvania that if it needs a certain amount of energy to start a train, it needs about nine-tenths as much to make an emergency stop. In local or accommodation trains the expense would be enormous, therefore, to so frequently reduce the speed as soon as it reached 120 miles per hour, if the electric current were used as the braking power. In the experiments I refer to, the momentum of the train was used for braking, while the electric current was merely the agent for controlling the application of the force of momentum. This force is very cheap and plentiful, and even with the crude apparatus employed, emergency stops were made in which the cost thereof was simply that of an electric current of two amperes acting for less than one second.

MR. CROSBY: In order to have any kind of service, whether you try it automatically or not, you have got to have it safe enough for a man to be on there. That is, you must not have so many accidents as would make it unsafe for a man to go on there, or your business would be gone. If you have an engineer he can have a man to sit by him and another man by him, and you go on till finally you have a passenger train. I do not consider it practicable to run a train that is of any size, enough to make it commercial, without a man on it. I think the enormous complexity of an automatic system that would take care of the entrance into a city and the departure from a city and of all the varying conditions of service, without a man on board, is really beyond anything that would stand up. You might put it all down to work and have trains on it, but I think the complexity would soon break it down. As to the desirability of fast trains for passengers I must disagree with the gentleman who last spoke. I see a gentleman from Chicago who shook his head very emphatically when the statement was made that people did not waat to travel so very fast. I think the limitation, so far as steam railways are concerned, is the ability of the engine to draw enough cars to accommodate people who want to go at that speed. That is what the New York Central people claim in regard to their limited train to Chicago. They cannot run any more cars, and have their engines make the speed that is wanted. People at Buffalo complain that they cannot get the fast service which people going from here to Chicago get. They have wanted additional cars put on, and the railway company has answered, "We cannot put on additional cars without sacrificing what we are aiming at, which is high speed."

CHARLES WIRT: I want to go on record as against these fast trains unless we can ride on them. I hope to see things fixed so that I can attend these meetings, and get back to my work in Chicago the next day. I can only attend about once in six months now. I ride on trains a good deal, and like to hold my watch in my hand and count the mile posts. I learned one very discouraging thing in doing this, which is that a train which may make a mile in sixty seconds will average no more than thirty miles an hour, and I would be glad to know whether the ratio of maximum to average speed will be any different for the fast running that we are considering.

F. L. POPE: I think Mr. Thompson is certainly in error in stating that fast trains have been discontinued by our railroads to any great extent. As a matter of fact, I believe that there has never been a time in the history of the world when there were so many fast trains running in this country, or so many running in England, as there are to day. I live on the route of the "Bound Brook line," which is certainly, all things considered, doing the best running in this country to-day—perhaps the best that is done anywhere. It is now operating a great number of fast trains, and they are increasing in number every year. Coming over from Philadelphia only a few days ago, I timed three miles by the posts, the other side of Bound Brook, in two minutes and twenty seconds, which I think you will admit is very good speed for a train of five cars.

DR. L. H. LAUDY: We have with us this evening a prominent railroad engineer, Dr. Dudley. If the chair will call on him, I think he will respond.

THE PRESIDENT: Will Dr. Dudley favor us?

DR. P. H. DUDLEY: I suppose Dr. Laudy prefers to have me tell you about some of the experiments I have made on the resistance of different trains. Those were made several years ago and not on as good tracks as we have at the present time. The resistance of the passenger train is given by the formulæ in books as seventeen or eighteen pounds per ton. I found on the Lake Shore & Michigan Southern Railway and the New York Central & Hudson River Railroad that with trains of about 250 tons the resistance was only from ten to twelve pounds per ton at speeds of from fifty to sixty miles per hour. The resistance per ton is not nearly so great on those long trains as on the short ones. With trains of two and three cars, sometimes it ran as high as thirty-five or forty pounds per ton, but with long trains it ran down to about ten and twelve pounds per ton.

The greatest variable that we find from day to day over the same track and same train is the wind resistance. I found, in one special experiment I made in 1878 to see why the New York Central was not able to make its time with its trains, that on a still day, with the schedules they had, they were able to make time, but a wind of ten or twelve miles would retard the trains so that in running from Buffalo to New York they would lose two hours. The trouble at that time was that the boilers were not large enough to quickly generate the steam required to meet the increased resistance. The trains would run up to a speed just about the capacity of the boiler and that would limit the speed they could maintain. Therefore, when a head or side wind was blowing against them, the speed of the train would be reduced very materially.

One gentleman spoke about the fast speed of the local passenger trains. The fastest speed usually found on trains is in the local passenger service, for five to twenty seconds—especially those stopping every two or three miles. They often attain a speed for a few seconds as high as fifty-five or sixty miles per hour. Then they shut off steam and apply the brakes to stop the train. The heavy trains of eight to ten cars, running long distances, rarely attain sixty miles an hour; that is, on the ordinary schedules.

The greatest improvement that has been made in decreasing train resistance is in the improvement of the track by bringing up the standard of excellence and the adoption of heavier and stiffer rails. I have been making a number of heavy rail sections for different railroads, and instead of making them simply heavy, I had made them very stiff, which has reduced the deflection or wave motion under each of the wheels. Comparing the resistance of the Chicago limited express on stiff eighty pound rails with that of sixty-five pound rails which have been on the track some time, it makes a difference of seventy-five to one hundred horse power per mile. I have just made some ninety-five pound rails for a road, which will be very much stiffer than the eighty pound rails. We find now that the condition in which they are keeping the line is so perfect that there is scarcely any oscillation on the best roads, and there is very little difference in the oscillation now in riding on a tangent or a curve. I should prefer a tangent for smooth riding, although the wheels press against the rails on curves. Unless they are properly elevated, there will be some oscillation, though our present trains move very steadily on the best tracks. I have made careful experiments and with a track in good condition the heavy cars ride very steadily, leaving little to be desired.

C. O. MAILLOUX: I think that there is one particularly good thing in Mr. Crosby's paper, which is the statement that the track is half the battle. Mr. Crosby is, I think, very modest. If I had made the statement myself, I would have said the track is nearly the whole of the battle. I remember hearing our past-president, Franklin L. Pope, whom we have the honor to have with us this evening, telling me in a very sententious way that the street railway people seem to feel perfectly satisfied not only to have grades of seven or eight per cent., etc., but to have one at the end of each rail. My experience has been that on many roads they are not even satisfied with that, but they have one between every pair of ties or several in each rail. Now in the matter of designing electrical street cars particularly, we have to contend with all those difficulties and we have to resort to theoretical reasoning, oftentimes, for want of practical data. Now I found that the ordinary data in relation to the traction on street railroads are entirely out of the way, entirely unreliable. The most authentic figures, if my memory serve me right, placed the traction at something like 13 pounds per ton. In practice, as the result of crude traction-dynamometer experiments I have found the traction below twenty pounds with a car having a considerable weight. I have found that the traction per ton reached in some cases over thirty pounds and it has gone as high as forty pounds. Calculating the traction theoretically, using the coefficient of friction on the axle, the weight, and the well-known formula, (since the power exerted is expended practically in overcoming the friction of the axles), one would expect to find a much lower traction. As a matter of fact, calculation gives a figure which is nearly in accordance with the data given by the engineers; yet practice always gives a higher figure by fifty per cent. and often more. I could not account for it unless it be that owing to the poor condition of the tramway rail surface, as the result of dirt, dust, depressions, etc., we have a greater amount, and a greater amplitude of rise and fall of the car as it rides over the minute excrescences on the track. I concluded from this that as the car is being continually and repeatedly lifted slightly we must introduce into the formula for traction a factor which is a function of the weight of the car itself; in other words that traction per ton increases with the weight of the car. I mean that the traction per ton for a car weighing three tons might be twenty to twenty-five pounds, while that of a car weighing seven or eight tons under the same circumstances might be probably thirty or thirty-five pounds. This view might explain the lower figures found for the traction of horse cars.

I would like to hear from Mr. Crosby in regard to the initial torque; that is the amount of traction which is necessary to overcome static friction; in other words what he finds the difference between static and kinetic friction to be. I have found in my experience that the intitial traction went up as high as 80 to 100 pounds per ton.

GEO. B. PRESCOTT, JR.: I can confirm to a certain extent what Mr. Mailloux has said about the unreliability of the traction figures for street cars that are given in some text books. Several years ago I had occasion to try a number of experiments with a storage battery car for the Sprague company and in the interest of the West End Railway company of Boston. It was very soon found from actual power expended that the traction factor did not agree with the figures given in the text books. In order, if possible, to determine the value of this factor under ordinary conditions of level track, we secured a pair of powerful horses from the street railway company, that were specially trained to start very gently and pull steadily. We took the car out on a nearly level track, and with an ordinary spring-balance attached between the car and the horses, endeavored by leaning over the dash-board to read the indications of the balance. This was found to be practically impossible owing to the rapid fluctuations of the indicator. Then followed a very amusing incident. Several gentlemen had been invited to ride in the car and witness the experiments. At this stage a rope was procured and the guests invited to act as motive power, much to the amusement of the street urchins who unmercifully guyed the gentlemen in silk hats and top-coats who were acting as car horses. A number of interesting readings were secured which seem to indicate that the condition of the track was not at all uniform, and it seemed to happen that when we were going to start the car it would always be blocked by a spike As this meant raising the whole weight of the car in starting, it was frequently impossible for the men who were pulling the car to get it over the spike, and we would have to push it back and get up a momentum; which probably goes to show that the traction coefficient is a function of speed. These experiments were continued the whole afternoon, and on a perfect level we found the traction to be somewhere in the neighborhood of 30 pounds to the ton for a car weighing about six tons.

DR. WILLIAM E. GEYER: I must ask a question which will subject me to the criticism of being an electric heretic. It has been stated over and over again this evening that in the case of electric locomotion, the main battle is the track. Now if the same attention were paid to the track, I would like to ask Dr. Dudley or any other railroad man, what in their opinion would be the possibilities with ordinary steam locomotion, if we are willing to spend large sums of money on the track and on maintenance, approximately as proposed by Mr. Crosby.

DR. P. H. DUDLEY: Our experiments are not sufficiently carried out to determine yet all those points. About the best results are those that I have given you, that is a reduction of nearly 100 horse power per mile, compared with the ordinary 65-pound rail. I have designed some 105 pound rails which are nearly 100 per cent. stiffer than the 80-pound rails. We will probably save on the fast express trains nearly 200 horse power per mile, as compared with worn 60 or 65-pound rails. We have not rolled such a large rail yet; but it will not be long probably, before that will be done. All trials show a very material reduction in train resistance with the heavy rails, as we increase the stiffness. I think it will be perfectly safe on a track of the 105 pound rails, to run 120 miles an hour. I have ridden several times 75 miles an hour on heavy rails and did not feel it nearly so much as on the light rails when running 45 miles an hour. There is scarcely any oscillation. The track is in perfect line and the joints are all kept up. I might show you on the black-board the shape of some of rails we find in tracks. Taking a 30-foot rail on our best tracks; its surface to the eye would be represented by a straight line as indicated in Fig 1. The joint is well maintained in uniform surface with other portions of the rail. Take even 65-pound rails, after they have been run over a little while, if the joints are laid opposite, we find the rails in this form, Fig. 2, down at the joints and high in the center. Now, of course, as the locomotive or train is passing over this depression, it further deflects and the wheels strike on the receiving end of the rail and cut out a piece from the head of the rail. This has been very common. Some times the effect is sufficient also to bend the rail down at this point. The apparatus I have on my car ejects paint on the rails where there is a certain deflection. In Fig. 2, it will be noticed the receiving ends of the rails are commencing to cut out. By ejecting the paint, the trackmen have been able to surface the track so that on rails 15 or 16 years old, they have not only checked the cutting out, but have brought up the surface of the rails to a much better condition, and they are nearly in straight line at the present time. One serious trouble with many of the railroad people is, that, while they want a heavy rail, they never consider the question of stiffness. I distribute my metal so as to make the section very stiff, not allowing so much in depth of the head of the rail as is usually done, but widening the head, because when these rails have been in the track a few years they become worn very unevenly, and must be removed from the track. I am making the heads on that account very much broader and the sections stiff, so the deeflctions of my 75 and 80-pounds rails is less than one-tenth of an inch in the track. We mark all those rails for any deflection exceeding three thirty-seconds of an inch, under a load of six tons per wheel. That is about as close as the trackmen can work on a 65-pound rail. On an 80-pound rail they can work closer, but require great skill. The ejection of paint also shows where there is a rotten or loose tie. The form of rail where the joints are low, and high in the center I call the first form. Then there is another form in which the joints and center are low, and high at the quarters which I call the second form, Fig. 3. Then there is another rail of which the surface is all full of waves. I call that the third form, see Fig. 4. A few years ago that was a very serious matter. We are often able to tell from the diagrams in the car, what mill made the rails as we run over them. That feature has been materially improved by the mills. You will see at once, with trains running over rails of the sevarions forms and with the deflections, there is a large amount of force lost. Rails

high in the center to the eye, will be loose on the ties, so that there is quite a wave under each wheel. Even with very good track we find that under each wheel there is a depression depending on the weight of the wheel and speed of train.

MR. LOCKWOOD: Before the discussion is concluded I would like to call attention to just one point more, which seems to have escaped attention so far, though I have no doubt that those of us who are experts in electric railroading have not overlooked it, and that is that with the increased use of electric locomotives we may expect to have better preserved tracks, and tracks which, moreover, will hold out much longer; because in the transfer of the rectilinear motion of the steam-piston to its connecting rod and in its transformation to rotary motion in the wheels there is a heavy pounding effect which will certainly be absent from the motor which has a rotary motion at the outset.

FRANK J. SPRAGUE: I was not here early enough to hear Mr. Crosby's valuable paper, but I have gathered the gist of some of the points from the criticisms made. I wish to take the decided position that no automatic system of high speed service for either passengers, freight, or mail will ever come to a commercial issue. I will go farther still: The moment you deny to a man the privilege of traveling 100 or 150 miles an hour you will have a flood of applications from people that want the opportunity. I know very well what Mr. Crosby's feelings are, and perhaps it was his belief in high speed service which brought him into the railway field. I will relate an incident, which will perhaps be new to you I do not remember what year it was that Mr. Crosby left the army, but it was six years ago that I was married, and he was my groomsman I saw him but one day, and a year or two later, I happened to be in New York city at the time when the Richmond road was under consideration, and I was casting about for some one to associate with me in my work. It was just after some experiments on the elevated railroad had been carried through. Mr. Crosby flashed across my mind. He was then down in New Orleans. I said to my wife: "The time has come when I must have some one to help carry the load, and I want a man about my own age, and one who has nerve and grit and coolness, so that if he gets on the front of a car that is going 75 miles an hour, and there is danger ahead, he will stay there." I said, "Do you think Mr. Crosby is that kind of a man? Has he that kind of nerve?" She replied, "I think he has." I went to the office, and telegraphed to him, "Can you come on to New York at once for a week?" He telegraphed, "Yes; I will come." He came on. We had a conversation, and the result was that Mr. Crosby resigned from the engineers' corps, and stands to-day as one of the foremost exponents of high speed service.

Mr. Crosby spoke of the possibility of returning the energy of the train to the line, and that it would have very little importance in dealing with the particular class of service of which he has spoken—high speed service over long distances. That is very true. I think perhaps the value there of a shunt machine, if used, would be on account of the constancy of the speed. That is, it would always be constant within a certain very small limit, especially with machines of the exceedingly high efficiency which would be used under those circumstances. That is where I think, perhaps, the shunt machines would be used. But on local rapid transit service, or service like that of the elevated railroads of New York city, which is not very rapid, but where we have stops every third of a mile, then the importance of returning energy to the line becomes at once very great, because from careful calculations I know it to be possible to return about 40 per cent. of the total energy used back to the line, and the facility with which this can be done increases very rapidly with the size of machine which is used. Where you can use shunt machines, and excite your field-magnets up to a very high saturation, and have a very reasonable latitude of variation, the criticism that was made that there would be a loss in energizing the field-magnets more than when in using series machines, I do not think holds particularly good, for this reason: That the total energy used in the field-magnets forms a very small proportion of the total amount of the energy used on the line, and if the return energy is 40 per cent. of the total, and the field energy of the magnet is only 2 or 3 per cent. of the total, the value of this method seems apparent.

The question of traction, which has been so ably spoken of by Dr. Dudley, has two entirely different bearings. If you are dealing with street car service it is one thing. If you are dealing with high speed, clean rail service it is an entirely different thing. I have found, so far as my practical experience goes, that the dirt on the track, the snow and mud, and the grades, were the questions that determined the power of the motors. When you consider that with 20 pounds traction per ton, the work on a one per cent. grade is equal to the work of traction, and that our street car service demands 12, 13, and even 14 per cent. grade work, the question of rail traction on a level amounts to very little in street car motor design, but it does amount to the greatest possible importance in high speed service.

Mr. Crosby was speaking, just as I came in, of the influence of currents on traction where the ground circuit is used. I was once a very zealous upholder, especially through our commercial agents, of the importance of using the ground circuit, because of the value of adhesion. My belief was founded on the experience I had with a very dirty track, for which the electricity was perhaps a sort of broom to brush away, or a fire to consume, the dirt. I am now of the opinion that the passage of the current, or at least so much current as is necessary for actual traction, has little influence on actual adhesion with clean rails. If it has any influence it simply acts as a cleaner of the track—nothing more than that.

J. STANFORD BROWN: The question of grades has come up and been discussed, but the question of curvature has not, unless it was taken up before I came in. I would like to inquire what limitations would be put upon that in this very high-speed service.

MR. CROSBY: In the paper as read there is a calculation for the limit of curvature as a question of safety. Now there is a very important question as to the effect of curvature in increasing the friction coefficient. On that I have been able to do nothing more than take the text-book formulæ, and I am not at all sure that they are all right. The matter of safety I have discussed in the papers. The power I have assumed ordinary coefficients for. As to the values of the coefficients in street railway work on straight track, I found with a dynamometer on an ordinary flat rail, about 25 pounds average per ton for a car weighing about 12,000 pounds, that is, a street car, on an average street car track. As to the starting effect, I started a car equipped with the ordinary Sprague motor with 14 amperes by having a water resistance external to the car. Of course, all cars, as they are made by all the companies that I know of, take a larger current than that to begin with under any conditions, simply because C is equal to E divided by R. You have so much R and so much E and you will have so much C. But that current is many times larger than is necessary to start a car. Those 14 amperes started a car on what was practically a level, rusty track, then I put a dynamometer in to check it, and as I remember now got about 175 pounds as the effort, applied gradually through a rope and a dynamometer to the starting of this car. That would be about 35 pounds—from 35 to 50 pounds per ton—and it checked exactly with the calculated torque resulting from the 14 amperes which were used electrically. In other words I started once mechanically by men hauling on the dynamometer, and then electrically, and they checked very well, running somewhere to 175 or 200 pounds for five tons.

Now another gentleman has not, I think, been answered as to the question he raised respecting the feasibility of steam as compared with electric traction, in case every possible improvement is made. I assumed in the paper I prepared previously on the subject that the traction coefficient would be the same for the same pull, no matter how exerted. It is so much per ton that has to be exerted. Now the way I took hold was to calculate this very thoroughly—this cumulative load—with steam, the coal necessary to be carried and the water and the surface opposed to the atmosphere in increasing your speed. I formed a table, which I believe is reliable, showing that at varying ratios for efficiency for electric locomotive machinery, and assuming what we know to be the average efficiency of the steam mechanism at such and such speeds, that you will have an economy greater in the one case or the other. It runs this way: If you can get ninety per cent. efficiency out of your electric service and have a frequent service—that is, of course an indefinite term, but I define in my calculation a particular frequency which is not excessive as compared with the local traffic, say, of the New York Central road—with such a frequency with ninety per cent. efficiency and at twenty miles an hour, the electrical propulsion is slightly more economical than steam propulsion. Now as you increase your speed the relative value of the electrical propulsion increases enormously, and finally at high speed, say 120 miles, your electrical propulsion is something like six times more economical than steam propulsion, considering steam propulsion even possible. But it is not possible to propel ordinary trains by steam at 120 miles for any length of line worthy of consideration, because the amount of coal and water that you are required to carry has reached a quantity that would require two or three tenders to take care of. You can see readily that it is a cumulative thing. Every pound of coal you put in requires some more coal to be burnt to pull that pound and you have to carry it, and you have water, so that when you get to the high speeds it is out of the question and we have nothing to look for at very high speeds, save electrical propulsion. But if we come to comparatively low speed service and a comparatively infrequent service the steam will beat us.

MR. PEIRCE: Do I understand Mr. Crosby then to mean that for heavy freight service steam would be more economical than electricity?

MR. CROSBY: Yes; I think for heavy freight service, unless its frequency is far beyond anything we have to-day, it can be carried on more economically by steam than by electricity. The table I prepared, I calculated with a great deal of care for the cost of generating so much power in the one method and in the other, and I also introduced as nearly as I could the dead weights needed for producing that power by the two agents. Those I will say are factors that have to go into it: The cost of producing one horse power hour and the number of tons of paying freight that one horse power hour can haul when that horse power hour is expended by the one means and the other. Those two things being considered, put them together in the equation and you have at once the speeds at which the one or the other agent becomes more economical.

MR. SPRAGUE: I heartily agree with Mr. Crosby in his opinion regarding the freight service—that it will be a long time before it can be more economically carried on by steam than by electricity; likewise long trunk transportation. You must understand that electric transmission is going to bring up a new system of train operating and train dispatching.

I think that in justice to Mr. Crosby I should explain why he was said to "have nerve." It was related that at a ballon ascension in the city of New Orleans Mr. Crosby got away in the balloon without the operator because he was bound to go. I feel, in discussing this subject, very much as that operator probably did. Mr. Crosby on this question of rapid transit has run away from me, simply because I know of it only through the discussion that is going on.

MR. THOMPSON: If I understand Dr. Geyer's question it was: "All other things being equal, why can we not safely use as high speed with the locomotive as with the electric motor?" There seems to be one certainty in favor of the electric motor as regards the matter of safety not found in the case of the locomotive. High speed means more danger of the numerous parts, such as connecting rods of the locomotive breaking; it means more danger of boilers exploding, etc. Where the armature is mounted on the car axle as proposed by the speaker, the electric motor has no extra moving parts over those found in an ordinary car—as against, I don't know how many moving parts in the locomotive—but a great number intricately involved; so that an electric train would have a very high per cent. of safety over the steam locomotive, whether the present track is improved or not.

THE PRESIDENT: This discussion is an exceedingly interesting one, but we have some other matters to come before us this evening, and it is past ten o'clock already. Franklin Leonard Pope, I believe, has agreed to tell us something about the history of Mr. Davenport's little locomotive here, which perhaps will run 120 miles an hour. I don't know whether he thought of doing it or not.

THE INVENTIONS OF THOMAS DAVENPORT.

BY FRANKLIN L. POPE.

The year 1837 marked a very important era in the history of the industrial development of electricity. During that year two of the most extraordinary inventions of the present century made their advent in this city—the electric telegraph of Prof. Samuel F. B. Morse, and the electric motor of Thomas Davenport. The motor came first. Davenport, a self-taught Vermont blacksmith, who had invented and constructed his machine in a remote country village in a crude form as early as 1834, came to New York in February, 1837, bringing with him some of the machinery which had been made for the purpose of exhibition by himself and Ransom Cook, with a view to enlisting capital to build a large motor. During the season of 1837 he occupied rooms in the city, where he exhibited models of his motor and various other electrical inventions. Articles were published in the newspapers of the day, and his exhibitions were attended by a great number of people. In letters written about that time Davenport mentioned that one of the most frequent visitors was Professor Morse.

With the history of Professor Morse and his invention of the telegraph the world is quite familiar. With the history of Davenport and of the invention of his electric motor—as I soon discovered in endeavoring to obtain information about it myself—scarcely anything is known. This difficulty ultimately led me to interest myself in trying to find out more about the matter. In this undertaking I was fortunately very much more successful than one can reasonably expect to be, in attempting to resuscitate the history of an invention which has lain unknown for the best half of a century.

The first newspaper notice of the electric telegraph which appeared in America was in the *New York Observer* in the summer of 1837. I will read you an extract from it:

"A gentleman of our acquaintance several years since suggested that any intelligence might be communicated almost instantaneously hundreds, if not thousands of miles, by means of very fine wires, properly coated to protect them from moisture and extending between places thus widely separated. It is well known that the electric fluid occupies no perceptible time in passing many miles on a wire, and if it is possible by connecting one end of the wire with an electrical or galvanic battery to produce *any sensible effect whatever* at the other, it is obvious that if there are twenty-four wires, each representing a letter of the alphabet, they may be connected with the battery successively in any order, and if so connected in the order of the letters of any word or sentence, that word or sentence could be read or written by a person standing at the other end of the wires. All the paragraphs of a newspaper could thus be touched by a man in Philadelphia, and the contents, *verbatim et literatim*, conveyed to New York as fast as a compositor could set up the type!"

It has always been a mystery to me what invention was referred to in that article. The *New York Observer* was edited at that time by a brother of Professor Morse. The "gentleman of our acquaintace" referred to was, no doubt, Professor Morse, but what was meant by the telegraph of twenty four wires I could never make out, because we all know that Morse never entertained any idea other than that of a single-circuit telegraph at any time from the beginning of his experiments in 1835, or earlier. But I received a few days since a letter from a gentleman who had read some articles recently published by me in reference to Davenport's work, in which he stated that he visited Davenport's exhibition in the summer of 1837, here in the city of New York, and that he himself saw in that exhibition a model of a telegraph of twenty-four wires invented by Davenport, and that model must undoubtedly be the telegraph referred to in the extract I have just read.

In pursuing my investigations into the history of Davenport's work, I was fortunate enough to find that several of his original models were still in existence. One of these models a circular railway two feet and a half in diameter with a locomotive traveling on it, similar to the one which we have here to-night, but very much more finely finished, I was able to satisfy myself by contemporaneous evidence was built in 1837. The one which is before you was found in the cabinet of the Female Seminary in Troy, formerly Miss Willard's. The records of the institution show that it was purchased in 1840, but it evidently must have been built by Davenport himself prior to the more finely finished model of which I have just spoken, which was constructed in 1836–7 with the assistance of Ransom Cook of Saratoga, a very ingenious person, and a finished mechanic. I think there is no doubt that the model before us was built in the early part of 1837, and possibly as early as 1836. Fortunately it is, as you see, in a very good state of preservation. I have had it mounted to-night with the same battery that was found with it—a three-cell Grove battery of pint cups, and I think we shall find that it is in tolerably fair running order. [The model was set in motion.] It does not go quite a hundred and twenty miles an hour, but it goes. This locomotive, you will observe, has a fixed field magnet below, and a revolving armature above, which is reversed twice in every revolution. So far as I am able to discover, that is a combination found in every practical motor to day, which Davenport was the first to

make known and to use in 1834. The motor is connected to the driving axle by bevel gear. The field and armature in the model before you are connected in series. In the other model of 1837, of which I spoke, they are connected *in shunt*. Among other models of Davenport was one having a horse-shoe field and a four-pole armature with curved pole-pieces, which is really quite an advanced type of motor. That also was built in 1837. Altogether, Davenport, between 1834 and 1840, built over 100 motors of different patterns and of varying sizes, scarcely any two of them alike. I discovered also, quite to my surprise, that he was undoubtedly the first to make use of the solenoid with a movable core as a means of moving machinery of any kind. He built in 1839 quite a large motor, operating upon that principle, which, from the best description I have been able to find of it, must have approached one horse power. He set that up at 42 Stanton street, in New York; attached a printing press to it and started to publish the pioneer electrical journal of America—a small weekly paper called "The Electro-Magnet and Mechanics' Intelligencer," printed by electrical power. Through the kindness of Mr. Davenport's son, Rev. Willard G. Davenport, I have the pleasure, on his behalf, of presenting to the American Institute of Electrical Engineers two copies of that paper. These, so far as is known, are the only editions ever published; they are number one and number two. This was in 1840. I have received within a day or two an interesting letter from H. S. Davenport, a nephew of Thomas Davenport, still living in Vermont at an advanced age, who, as a boy, was with him a great deal and in that way became quite familiar with his work. I will take the liberty of reading extracts which give some idea of the manner of man Mr. Davenport was. He says:

"Many of his models never left his shop and were but little known even at the time of their construction. They were only made to show to how many uses the power could be applied, also to work from on a larger scale, if he could get pecuniary aid to do so. The different models which interested me most, at the several times I was in his shop, were a trip hammer, a turning lathe and a machine for doubling, twisting and reeling cotton or silk, all at the same time. A circular frame fitted with two intersecting tracks, on which four miniature cork images glided around, he called his 'puppet show.' He was naturally of a retiring disposition, but when waked up was very strong in argument. His two favorite subjects were nature and electromagnetism. He considered magnetism the most important element in the creation of the universe and thought it would be in its destruction. Magnetism kept the heavenly bodies in their places, and if that failed everything would be turned to chaos. He could see in every rock of the earth the battery of which it was composed. So also in the animal kingdom, the bones, muscles, and blood constituted a complete battery, which exercised a repulsive or attractive force with respect to another organism of the same kind. He was a great lover of fun and exceedingly fond of a joke. On one occasion he received an order from a party in Chicago for a half dozen bottles of electricity. He said he knew by the tenor of the letter that it was intended as a joke, and he accordingly replied that he bottled up his *wrath* for such would-be-ignoramuses as he was, but had no electricity for him."

I might go on and relate many other facts of interest which I have learned about Mr. Davenport and his inventions, but the hour is already late and I will forbear. But I may remark in conclusion, that I find him to have been one of the most interesting characters with whom I have ever become acquainted, and I cannot but feel highly gratified that my attention chanced to be directed to the subject, in season to rescue at least some of the more important of his work from impending oblivion. In two or three years more it would have been too late. There are people now living, although at an advanced age, who knew him and remember him perfectly, but in a year or two more perchance they will be gone.

On motion of Ralph W. Pope, the gift of Mr. Davenport was accepted by the institute with thanks.

Telegraphers' Troubles.

The Order of Railway Telegraphers is having a good deal of trouble of late. The last difficulty promises to be quite serious. It is reported that S. H. H. Clark, general manager of the Union Pacific, has issued an order instructing the general superintendents to ask all the telegraph operators on their respective divisions to withdraw from the Order of Railway Telegraphers, and to discharge all who refuse. This order has been executed, and every operator on the entire system from the Missouri River to Portland, Ore., and from Denver to the Gulf, received a notice to withdraw from the order or resign from the service of the company. No reason was given for this demand except that the company did not wish the operators in its employment to belong to such an organization. There was a great deal of discontent expressed at the order, and many were in favor of resistance.

A railroad official is reported as saying: "It was discovered that some kind of an organization was being agitated by certain members of the order for the purpose of resistance, and it being thought prejudicial to the interests of the company, an order was promulgated for all the Union Pacific operators to withdraw from the order, as it was thought they would not be apt to concoct mischief if they did not have the support of the order back of them. The feeling among the men is that they will strike rather than submit."

A dispatch from Pueblo, Colo., says Chief Thurston is in that city investigating the trouble. He hopes to be able to arrange for a conference at which the men can show that the company has been misinformed. It is believed by the officers of the association that the company's order against the members will be withdrawn.

Train Lighting by Electricity.

In a paper before the Western Railway club, George Gibbs, mechanical engineer of the Chicago, Milwaukee & St. Paul railroad, makes the following statement regarding train lighting by electricity: "The electric system may be considered adapted, in the present state of the art, to *special* service only. It fills a number of the requirements for a perfect light in a manner that no other light approaches. It is cleanly, cool, safe, allows excellent distribution, and is, in fact, a luxury which is duly appreciated by the traveling public. Unfortunately, from a railroad point of view, it is not such a success. It is costly, is adapted to special service only, and requires great attention to details. Still, in many instances, it will undoubtedly pay for itself many times over; and each railroad manager must consider for himself whether under his special conditions its use is warranted."

The New Ward Arc Lamp for Incandescent Circuits.

One of the most noteable developements in modern lighting practice is the employment of arc lamps or incandescent circuits, and the success which has attended the introduction by the Electric Construction & Supply company of New York, of the New Ward Arc Lamp, for this purpose, shows that lighting concerns recognizes the advantages of the system. In central station works the use of arc lamps on constant potential circuits is rapidly increasing, as shown by the installations at the Edison stations in New York, Boston, Chicago, Minneapolis and St. Paul and elsewhere. A noteworthy fact, also, is that the Edison Illuminating company in Brooklyn has alone installed 625 arc lamps on its incandescent circuits. There are many conditions where it would be both difficult and expensive to extend the arc system, and wherever the incandescent circuits are available they can now be advantageously utilized both for inside and outside lighting. A station using say, 100 lamps, can furnish light, it is said, at 6 cents per hour per lamp, and the customer can use just what light he wants, and pay for just what he gets. An important consideration in this system from an economical standpoint is the saving effected by the ability to dispense with more than one set of apparatus.

For isolated work this system possesses points of remarkable adaptability. Its particular excellence is well shown in the illumination of large spaces, and in filling the requirements of many special locations. It has been adopted with marked success in breweries, sugar refineries, railway sheds, waiting rooms, offices and large factories all over the country. Of the many leading brewers of New York who are now using it on an extensive scale may be mentioned George Ehret, Peter Doelger, and Messrs. Ballantine, and Rubsam & Harmann. Other successful installations are the Worthington Pump Works, Brooklyn, 72 lamps; Grand Central Station, New York, 44 lamps; Manhattan Real Estate Association, New York, 56 lamps, and the De La Vergne Manufacturing company, New York, 38 lamps.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 14.—One of the most important schemes for rapid transit in subways was presented to the Rapid Transit commission at its last meeting. The commission is getting down to practical work. The nature of the system which the City Railway company introduced was explained in detail by J. Coleman Drayton, Prof. Trowbridge of Columbia College, and Col. Hazard. This subway is to be built just beneath the surface running underneath streets and blocks. The subway is not to be a tunnel but a shallow cut covered by a bridge strong enough to bear the traffic or the buildings above. The advantages claimed for this system are: It can be construsted in the shortest possible time; perfect ventilation can be secured; the cost of construction is estimated at a figure which will insure a good return for the investment; and the railway operated by electricity will be noiseless and in close communication with the streets above. At the meeting Jacob H. Scheff of the banking house of Koen, Loeb & Co., spoke of the financial difficulties in the way of any rapid transit scheme and argued that the city should supply a system of rapid transit simply as a matter of economy. The commissioners have engaged W. E. Worthen as consulting engineer.

At the several meetings of the Board of Electrical Control during the week the matter of telegraph lines on both sides of the streets was considered. The mayor wanted to know why his orders had not been carried out in the case of the Western Union and the Postal Telegraph companies in Lincoln avenue. One line must be removed he said and both companies forced to use one side of the street.

The mayor has notified the subway company to continue the work of constructing subways for electric light, telegraph and telephone wires. He gave orders that unless the wires on Broadway between Houston and Fourteenth streets are underground by the first of next month he will have them taken down by the Department of Public Works.

In connection with this matter Mr. Lauterbach, representing the Consolidated Subway Construction company, stated that of the sixty-six and one-half miles of subways constructed last year under orders of various companies, only about four and three-quarters miles have as yet been occupied by the companies.

Several representatives of companies present explained that they could not make the necessary connections because Commissioner Gilroy would not allow the streets to be opened in winter. Engineer Kearney said that the Commissioner had been issuing such permits right along.

"Well, if these companies aren't in that subway by April 1, order all their lines cut down," said the mayor.

Henry Villard has sailed for Europe on the Lahn. He will be gone about three months. The purpose of his trip, it is understood, is to raise new capital in Germany for his American enterprises. One of the things he expects to do is to place the new loan of $10,000,000 on his Milwaukee street railway properties. For another thing, it is said, he desires to make a new syndicate to re-acquire the voting control of the Northern Pacific Railway. Mr. Villard's family is in Europe.

The State Railroad Commissioners this week resumed the consideration of the trolley electric system in connection with the Huckleberry or Harlem Bridge, Fordham and Morrisania surface road. The meeting was held in the Chamber of Commerce. It was developed that the road had a majority of 57,000 consents to the introduction of the trolley system on the Third avenue part of the line, but that the majority of the residents along Boston avenue objected.

The Commissioners closed the hearing and took all the papers in the case. They will consider them at Albany.

John Freeman, a clerk, was instantly killed by electricity in this city while trying to shut off the current from an electric motor.

Attorney General Tabor of New York, March 9th filed motions to dismiss, affirm, or advance the cases of the appeals brought by Shibuya Jugiro and Joseph Wood from the decisions of Judge Lacombe, refusing to grant them writs of habeas corpus. The men are under sentence of death by electricity.

The general grounds for the motions of the attorney general are that it is essential to the administration and execution of the criminal laws of the state that the appeals should be speedily settled, and that the cases are brought here on frivolous statements for the purpose of delay.

In the assembly at Albany a bill has been introduced by Mr. Gillette extending the powers of the Niagara Falls Power company. There is also an amendment to the death penalty act pending which provides for striking out of the bill the provision prohibiting publication of reports of details of these executions. W. H. T.

San Francisco, Cal.

SAN FRANCISCO, Cal., March 11.—California seldom experienced such a severe storm as that which raged from Saturday a week ago until the following Monday, and incidental to the wrecking of a ship off the Golden Gate, the loss of eighteen lives, the blowing down of several unfinished buildings, etc , was the great amount of trouble imposed upon the telegraph, telephone and electric light companies throughout the state. In San Francisco telephone and telegraph poles were blown down in several places, the most serious damage being the prostration of the Western Union pole line on Valencia street, from Market to Sixteenth streets. This pole line carries the San Jose, Santa Cruz and Monterey wires, but communication with these cities suffered no serious interruption, owing to the lines which run down to San Jose along the east side of the bay. No trouble of any kind was experienced by the electric lighting companies on the recently constructed circuits, and for once, despite the severity of the storm, the usual newspaper story about "electrical pyrotechnics," etc., was conspicuous by its absence. Last Saturday night the wind blew nearly fifty miles per hour. Snow and sleet is almost unknown here, and the California lineman has no personal knowledge of the havoc that wet snow is capable of playing with outside circuits. In 1885 about an inch of snow

fell in San Francisco, and the whole city, linemen included went wild in the sport of snowballing.

Another disturbing element to the eastern electric lighting, telephone and telegraph man from which the Californian is happily exempt—or nearly so—is that of lightning. Here, "the forked flash" is a decided novelty, and I do not remember that lightning has occurred in San Francisco for five years. Last week's storm developed a genuine thunderbolt, in Vacaville, Solano county, Cal., for the first time in the history of the county, a building was partially wrecked, and telephone and telegraphic communication was interrupted. With no extremes of heat and cold, with no snow or sleet, and with but little or no lightning the California lineman—and central station man as well—is certainly favored.

A Mr. Whyte of Pomona, Los Angeles county, has constructed a telephone line that is a novelty. It is six miles in length, and the line consists of a barbed wire fence, which very conveniently runs along the shortest route that could have been selected for the line. The barbed wire is insulated at every post by pieces of rubber garden hose, and the line is said to give satisfaction. Including the rent of the instruments for six months the line cost less than $75.

A press dispatch from San Jose states that suit has been brought by James W. Rea against the directors of the San Jose Electric Light & Power company. The complaint alleges that the corporation has been taking an active part in politics, and has been paying a monthly subsidy to the San Jose *Times*. It is averred that during the last city election the corporation expended several hundred dollars in its endeavors to elect certain city officers, and has paid $100 to the support of the *Times*, and also expended several hundred dollars in attorneys' fees and costs in a litigation conducted by one of the directors in his individual capacity. It is charged that this is a misappropriation of the funds of the corporation, in which Rea is a large stockholder, and judgment is asked, that the directors be compelled to return the money to the treasury of the corporation.

The governor has signed the Electric Railroad bills referred to in last week's letter.

In November last the installation of a 500 light incandescent plant for the Grant's Pass Ore. Electric Light & Power company, was completed by the Pacific Electrical Storage company of San Francisco. The installation consists of two Edison dynamos and one series of 55 "15 L" storage batteries of the Accumulator company of New York. The plant is giving excellent satisfaction, and will soon be increased by the addition of another series of accumulators, so that the three wire circuits of the town may be operated from storage batteries. In addition to this the station operates a 50-light Van Depoele arc machine. Both steam and water power are used.

Some months ago George L. Henzel, a well-known electrical contractor of San Francisco, applied to the Board of Supervisors for a franchise to erect pole lines and to operate a central station at his electrical works in the western addition of this city. For reasons best known to themselves, the supervisors refused to grant the franchise. and thereupon Mr. Henzel, emulating the example of the Electrical Improvement company, began to string housetop wires. He had lights placed along Steiner, California and Fillmore streets, and expected to start up on Christmas eve, when the chief of the fire department interfered and prohibited the use of the circuit; but Henzel secured an order in court restraining chief Scannell from tearing down the wires. The action of the chief was based upon an ordinance prohibiting the attaching of any electric lighting or power wire "to or on" any building. Henzel has brought suit testing the validity of the ordinance. The case has been heard, and it is expected that a decision will be handed down during the coming week. Meanwhile the embryo station is tied up. The Ball system is to be used, and power is to be derived from gas engines.

The Edison General Electric company is installing a motor plant in the Grover mine at Amador City, Amador County, Cal. It consists of a 40 kilowatt generator of a potential of 220 volts, and two motors—one 20-horse power, at the 400 foot level, and one 15-horse power, situated at the 700 foot level. The generator is worked by a 3-foot Pelton water wheel, running with a water head of about 400 feet. This mine is one among thirty or more that are on the mother lode in Amador and Placer counties, Cal. The installation has awakened a good deal of interest among mining superintendents. Although the water power is abundant, still the direct application of it is very difficult, and fuel is very expensive. The pumps are the Dow Triple cylinder pumps, and have a capacity of about 15,000 gallons.

The Edison company is installing two central stations of 750 lights capacity, each at Hanford and Tulare, Tulare county, Cal.

Geo. B. Markle, president of the Muttnomah Electric street railway company of Portland, Ore., has contracted with the California Engineering company of San Francisco, to furnish a complete steam plant for a new station that will be one ofthe finest electric railway power plants on the Pacific Coast. When completed the plant will comprise five 60x16 tubular boilers, and two 150-horse power improved Wheelock engines,each equipped with an independent manilla rope transmission of the Dodge American system. These engines will drive the generators. Hoadley Bros. of Portland will superintend the construction of this power station, and when it is completed the company will be prepared to give the public the same efficient service on all their new lines, which they now furnish on Washington and B streets. The cost of the machinery and improvements will be about $50,000.

The local telephone company has extended its long distance lines to Monterey and Pacific Grove, giving unbroken communication between these towns and San Francisco. The lines are constructed of specially prepared extra heavy copper wires, and are equipped with the latest appliances. Long distance offices have also been established at Gilroy, San Juan, Hollister and Salinas.

Since the enactment of the electric railroad bills in this state electric railway matters here are "looking up," as they would have done long ago had not such an unreasonable and senseless embargo been placed upon them. The first definite step in the direction of an electric road for San Francisco was taken yesterday, when a number of influential men representing the residents of Portrero, appeared before the street committee of the Board of Supervisors,and asked permission to use electric power on the proposed line from Market street along Seventh street, and over to Portrero—the portion of San Francisco where the Union Iron Works, the Pacific Rolling Mills and other large manufacturing interests are located. The petitioners presented the advantages of electric traction, and it was promised that should the franchise be granted the road would be in full operation within a year, and that the property owners on the streets involved would raise a $10,000 bonus, and give it and the franchise to whoever should build the road. Objection was made to the overhead electric system on the ground of alleged danger. The petitioners asked that the franchise be granted for at least ten years, at the expiration of which time they would discontinue the use of overhead wires. The petitioners already hold a cable franchise, but they want to operate an electric road. The matter was laid over for a week, and in the meantime the committee will confer with the mayor.

Specifications for the incandescent lighting of D. O. Mills' ten story building, now in course of construction in this city, call for 3,160 16-candle power lights, and three 56 kilowatt dynamos. Burnham & Root of Chicago are the architects.

The Interstate Fire Alarm Telegraph of Richmond, Ind., has secured a contract for placing a Richmond system in San Bernardino, Cal. S. F.

Detroit, Mich.

DETROIT, Merch 14.—Explosions due to the leakage of natural gas into electric wire conduits have occurred frequently of late in this city.

The two electrical companies at Kalamazoo have come to an agreement by which the City Electric Light company, operating the National system, is to do the incandescent lighting, and the Thomson-Houston company the arc lighting.

The Ann Arbor Street Railway & Lighting company has recently extended its line and put in new motors and generators.

A resolution has been introduced into the State senate at Lansing making the rental of telephones $10 per annum.

Marquette is to have a street railroad, and the company known as the Marquette & Presque Isle Railway company gave a contract to the Thomson-Houston Electric company to equip the line and furnish power. Three motor cars will be put on.

The Detroit Electrical Works are receiving flattering indorsements of their new Rae single motor street car system and what is better still they have received since the first of the year orders for the equipment of several new roads and orders for sample cars to be tested by several of the old companies. Among their late orders is one for two cars, to be equipped with 30 horse power motors mounted on Brill trucks, from the Augusta Railway company of Augusta, Ga., and two of the same pattern from the Richmond & Manchester road of Richmond, Va. They have also just completed a new standard 40-horse power motor which will be mounted on a McGuire steel truck and shipped this week to the Lake View & East Cleveland Street railway of Cleveland, Ohio. A McGuire steel truck is also being fitted out with a 30 horse power motor for the Rochester, N. Y., City railway which will also be shipped within the next ten days.

This volume of business has necessitated an increase in the executive force of the company and the employment of a large number of additional workmen. Louis Warfield has been elected treasurer and general manager. Joseph E Lockwood, recently with the Brush company at Detroit, has been appointed electrical engineer and will be associated with Mr. Rae in the management of the electrical department. W. B. Ferguson, who for many years held a responsible position with the Thomson-Houston company in the East, has been appointed New England agent of the company with an office in the new Exchange building, Boston.

Brownlee & Co. have just shipped 1,600 octagonal poles to the Minneapolis Electric Street railway to be used in completing the great Villard system. They have also just completed the shipment of 1,000 cedar poles to the Houston City Railway company of Houston, Texas. In order to accommodate the business they have bought 25 acres of land just outside of Detroit, having rail and river facilities. They are now removing their pole yard from Northern Michigan. This will bring them 200 miles nearer their customers and give them superior facilities for quick shipment and prompt delivery.

The Michigan Electric company, of which H. H. Humphrey is the controlling spirit, has just been removed to a new office and factory 212 and 214 Griswold street and is now prepared to turn out any amount of work that may be offered. Mr. Humphrey is going into the supply business also with his new company and has secured the agency for Michigan for the Star Electrix company, the Card Motor company, H. T. Paiste and the Great Western Electric company of Chicago, and is fitting up a fine store room for the display of the goods. This company will also manufacture a new motor of novel design. At present only one size will be made and that of one-quarter horse power, for compressing air for air brushes used by artists, for which a arge order has been received.

The Shawhan Machine Works are bringing out a new generator for lighting and power purposes; the patterns for which are now being prepared in several sizes ranging from 30 to 500 lights. This company is doing a large amount of repair work with prospects ahead for an unusually busy season. F. W. G.

Milwaukee, Wis.

MILWAUKEE, March 14.—In his annual report Chief Foley of the fire department recommended that the various electric railway companies be compelled to erect poles in the middle of the streets, instead of at the sides, on the ground that the poles and the cross wires interfere with the work of the department, and that the present system is absolutely dangerous to firemen. Both companies operating electric cars in this city—the West Side Railroad company and the Milwaukee Electric Railway company—have their poles along the sides of the streets. In fact, when the electric car system was about to be introduced here, the city officials would not listen to any talk of putting the poles in the middle of the streets. The Villard lines, constituting the great bulk of the street railway trackage of Milwaukee, are about to be equipped with electricity. An ordinance requiring the company to put its poles in the middle of streets has been introduced in the common council. Henry C. Payne, Villard's representative, states that it has been decided to use the side-pole system, and that a change would entail considerable loss and trouble. He adds, however, that the change will be cheerfully made if it is requested by the city officials.

F. E. Hinkley of Chicago, the president of the Milwaukee Electric Railway company, has begun proceedings in the superior court for the appointment of a receiver for the line. He avers in his complaint that the present company succeeded to the old Milwaukee Cable company, which had been organized with a capital stock of $250,000, and that the new corporation was capitalized at $500,000 and allowed to put in electricity. Only a portion of the stock, according to the complaint, was legally issued. The balance was not paid for according to law and is void, the complaint avers. It is further stated that bonds to the amount of $500,000 were authorized, but only $250,000 were issued, and it is claimed that they were issued in an illegal manner. The latter claim is founded on the nonpayment of money for the bonds. Hinkley claims that he is a creditor in the sum of $100,000, or more, and that the company promised him bonds for the money, but that the trustees of the road, the National Trust company of Chicago, was directed by other officers not to issue the

bonds to him. He claims the rights of a bondholder and asks that a receiver be appointed. He states that the company is threatened with suits that will imperil its operation.

Mr. Hinkley's allusion to an illegal issue of bonds refers to those held by Charles Pfister. The law requires that bonds shall be issued at no less than seventy-five cents on a dollar, and it is alleged that Mr. Pfister paid but fifty cents on the dollar for those he holds. In other words, he is said to hold $250,000 of bonds for which he paid $125,000, the amount of the claim that he holds against the road. Hinkley's actual investment in the road is said to be $115,000. The other side, however, claims that instead of being a creditor, Hinkley is a debtor of the company. His subscription to the capital stock amounted to $250,000, and he is said to be responsible to the company for the difference between that sum and the $115,000 which he put in. Hinsey and Hinkley have been at loggerheads almost from the start and, it is said, that both would be glad to sell out. Hinkley, however, thinks that he ought to have the profits of a sale, as he put in most of the capital. Hinsey, on the other hand, is of the opinion that the franchise which he secured while a mem- of the council, is worth something and so he has been figuring on having a good share of the proceeds of any sale. The other stockholders side with Hinsey.

The loan of $125,000 from Mr. Pfister was secured last July and fell due on January 20. The company could not pay it at maturity, and Mr. Pfister, it is said, agreed not to press payment on the condition that a certain amount of stock should be made over to him, to be advanced proportionately by Hinsey and Hinkley. Under this arrangement, Pfister holds $252,000 of the stock, Hinkley $138,000 and Hinsey $110,000. The annual meeting of the company was to have been held on Monday. When he applied for a receiver, Hinkley secured an injunction restraining the company from holding its annual meeting. He was afraid, it is said, that Pfister and Hinsey would oust him from the management.

The Hinsey people say that the road is worth $400,000 and that the floating claims against it amount to only $15,000.

Julius Meyer of New York will have charge of the work of transforming the Cream City and Milwaukee City railways into electric systems. The consolidation of the two roads has been perfected and the Milwaukee Street Railway company has succeeded the old corporations. It is probable that the Farwell Avenue and Walnut Street-National Avenue lines will be equipped with electricity first. A belt line will be built in the center of the city, on East Water, West Water, Martin and Huron streets. The company will build some of its own cars, but it will need so many and in such a short space of time that most of them will have to be manufactured elsewhere. By fall it is expected that the lines will all be equipped with electricity. When the work is finished Milwaukee will have nothing but electric railway lines.

In the common council a resolution has been introduced endorsing the bill now pending in the legislature to confer upon the wards the right to make separate contracts for street lighting. It is in the hands of the judiciary committee. The measure, it is expected, will be strongly opposed by the Villard people. They have the electric street lighting at present, and their company is the only one capable of furnishing electric lights for all the streets in the city. There are two or three other companies with a capacity to light a ward or even smaller portions of the city, and if the proposed rule was adopted they might secure patronage at the expense of the Villard interests.

The National Home & North Greenfield Railroad company has taken steps to secure from the town boards of Greenfield and Wauwatosa a franchise to build an electric railway on the Mukwanago road. The Milwaukee City Railway company secured a similar franchise some time ago on condition that the line would be completed by a certain date, but the time has passed and nothing has been done. It was the original intention of the Greenfield company to build a line through the city.

John H. Crotty, a popular young telegrapher, is dead. For several years he was assistant night manager at the Western Union office. He was a member of the Telegraphers' Mutual Benefit association and of the Wisconsin Electric club. C.

Denver, Colo.

DENVER, March 13.—Officers of the Denver, Lakewood and Golden Electric road have just returned from Chicago and other Eastern points where they placed contracts for material and equipments which they claim will make this new suburban line the finest in the United States. The contract for the through passenger cars has been awarded the Pullman company. Four of these cars will form the first complement of the road. Lighter cars will be used for the suburban traffic proper. The freight car contract calls for about $50,000, the intention of the company being to do a light freight and express business between Denver and Golden and intervening suburbs. Contracts have already been let for the electrical apparatus of the road, which will cost about $250,000.

A contract has been placed in Chicago for 1,300 tons of 60-pound steel rails. The entire grading of the line is completed and all the material for the line is expected to be on the ground by May 1, when operations will begin in earnest. The entire cost of constructing and equipping this line is expected to reach $600,000.

The Colorado Springs Rapid Transit company will make extensions and improvements in its line this spring. Three extra dynamos and a three-hundred horse-power engine have been ordered and an extension of the present power house will be made at an aggregate cost of $40,000. Two new extensions will be built. C. W. C.

Louisville, Ky.

LOUISVILLE, Ky., March 14.— During the week the Edison company erected an electric hoist for the New Albany, Ind., Light & Power company, and contracted with the Highland Consolidated Railway company of the same place to supply all cars on their lines with Edison electric railway equipments.

The new steam ferry boat Jeffersonville, which will run between Louisville and the city after which it is named, will be equipped with an Edison electric light plant.

The name of the Gooch Electric Light company of this city has been changed to that of the Citizens Electric Light & Power company, and the capital stock has been increased from $100,000 to $300,000.

The extensive additions to the electric light plant of the New Albany Gas Light & Coke company have been completed.

The Louisville Gas company has taken steps toward filling its contract to light this city by electricity. Two weeks ago several thousand poles were received and, on Monday last, the work of erecting them was begun. Four will be placed on each intersection, two at the corners and two in the middle. President Morris says that the plant will be ready for operation about July 1.

The new Williard hotel has awarded a contract to the Edison company for an electric light plant. About 500 lights will be used.

The new power house of the Louisville City Railway company is being rapidly pushed to completion. Four compound Williams' engines are in place, and the Edison company is engaged in fitting it out with generators and other equipments.

The John P. Morton Publishing company has contracted with the Edison company for an electric light plant.

The contract for wiring Harris' theater has been let to the Falls City Contract company. C. C. Y.

Indianapolis, Ind.

INDIANAPOLIS, Ind., March 12.—Joseph S. Qualey and Harrold Sturgis of Chicago have been in the city during the present week in consultation with representatives of the Broad Ripple Electric railroad. It has not yet been decided what system will be used, the overhead or storage battery. The county commissioners have extended the time for completion of the work to July 1.

In the matter of city lighting President Conduitt of the new board of public works, said, "We will take plenty of time to consider the public light question. In a matter of so great importance I believe in making haste slowly, and then when it is done it will be well done."

Among the bills passed by the Indiana legislature was one authorizing stockyard companies to operate electric lightingp lants, etc.; this is in the interest of the Chicago company, which proposes to locate in Northern Indiana. M.

ELECTRIC LIGHT.

An electric light plant will shortly be installed at Leesburg, Va.

At Stanford, Ky., the Stanford Water Works company will probably establish an electric light plant.

The East Alabama Improvement company will establish an electric light plant for Phœnix City and Girard, Ala.

The Citizens' Electric Light company of Baton Rouge, La., contemplates an expenditure of $10,000 to improve its plant.

A stock company will probably be organized at Aiken, S. C., to erect an electric light plant and make other improvements.

It is stated that the Key West, Fla., Gas and Electric Light company will increase its capital stock $49,000 and put in a $40,000 electric light plant.

The linemen of the Municipal Electric Light & Power company, St. Louis, threatened to strike last week because the company changed the method of paying them from $60 per month to $2.30 per day. The trouble was averted temporarily, however.

The Chehalis, Wash., city council has decided to purchase an electric light plant without delay. A committee of three councilmen has been appointed to ascertain the cost and perfect arrangements. It is desired to have the works complete within thirty days.

The Eddy Electric Manufacturing company of Windsor, Conn., will increase its present plant soon by erecting a new three-story building. This company is putting in an extensive lighting and power plant in the large new factory of the Eastman company at Rochester, N. Y.

Electricity has entered largely into the operations of the sporting fraternity. Last year base ball games were played at night by means of the electric light; the games are scored by electrical devices, home runs are recorded by the same means and now it has been decided to have horse racing at night at West Superior, Wis.

W. De Bolt of St. Louis, president of the Creal Springs, Ill., Mineral Springs hotel, has closed a contract with the National Electric company for the erection of an electric-light plant at that point. The plant will consist of 300 incandescent and ten arc lights, and in addition to lighting the hotel will also light the streets of the city.

A new electric plant costing $110,000 is to be erected in Tacoma, Wash. A three story brick building, 80x120 feet on the ground, is to be constructed. There will be two 1200 horse power engines and ten new dynamos, with a capacity for 2,500 arc and 5,000 incandescent lights. The boilers and engine room will be on the first floor, dynamos on the second, and the workshop on the third.

The new Standard Electric company of Ottawa has a capital of $500,000 and proposes to do an extensive incandescent and power business. The Royal Electric company of Montreal will supply the electrical machinery. The Ottawa company proposes to install from 12,000 to 15,000 incandescent lights, and about 500 horse power during the coming year. This is one of the largest electrical contracts ever made in Canada.

Representatives of some of the electric lighting and power companies of Kansas City visited St. Louis last week. The Kansas City companies are considering the question of allowing the wires of one company to be extended upon the poles of another, and the power of the Board of Public Improvements to compel the companies to use the poles of other companies, which is practiced in this city. The visitors secured A. J. O'Reilly's affidavit to the fact that some of the poles in St. Louis supported wires that were carrying the currents from five different machines, and they were not regarded as dangerous.

Professor Kohlrausch has reported on the experiments which have been made in the electric lighting of railway trains between Cannstadt and Stuttgart, in Germany, and his conclusions are that such lighting must be independent of the locomotive, and that it must be on the accumulator system. He disapproves of carrying a dynamo, owing to the consequent increase in the number of couplings in the train, and advocates charging the accumulators by means of fixed engines at various stations, and changing the batteries when approaching exhaustion. This system is stated to have been successfully carried on by the Oerlikon company on Swiss railways.

A London electrical paper makes the interesting announcement that the dean and chapter of Durham cathedral have allowed the installation of an experimental electrical plant for lighting a portion of that historic edifice. It is stated that the choir is lighted by 48 16-candle power lamps, supplied by a compound dynamo, driven by a small vertical engine placed outside the building. If the lighting is considered satisfactory the whole structure is to be lighted and the water power of the river Wear will be utilized for driving the dynamo. Secondary batteries will be also installed and charged during the day, and used for lighting the adjoining residences of the canons in the evening.

At a recent Baltimore wedding the guests were treated to a novel electrical display. No sooner had the company been comfortably seated, it is reported, than the room burst into a flood of light from numerous varicolored incandescent electric lamps hidden among the decorations. The entrance of the bride and bridegroom was welcomed by the automatic ringing of electrical bells, and the playing of electrical musical instruments. After the first course the room was plunged into semi darkness, when suddenly from the floral decorations upon the table there glowed tiny electric lamps. Not only the flowers, but the interior of the translucent vases in which some of them were gathered scintillated with flashes of light. After a while a miniature electric lamp, which in some unexplained manner had attached itself to the bride's hair, was seen to glow with dazzling brightness. A toast having been given two serpents slowly uncoiled themselves, and issued from the wine bottle that stood before the bridal couple. Cigars and coffee were served, and the cigars were lighted by an electrical lighter, while the coffee was prepared in full view of the company by an electrical heater. The speeches that were made were liberaly applauded by an electrical kettle-drum placed under the table. As the company dispersed the electric current set off a novel pyrotechnic display, amid the crimson glare of which the festivities ended.

The Thomson-Houston Electric company reports the following sales of arc lights: Ashland, O., 50; Lowell, Mich., 50; Mansfield, Pa., 25; City of Chicago, Ill., 50; Elyria, O., 70; Louisville, Ky., 50; South Chicago, Ill., 150; Greenville, Mich., 60; Lincoln, Neb., 150; Newport, Ark., 50; Joliet, Ill., 150; Arkadelphia, Kan., 30; Medina, N. Y., 50; Olathe, Kan., 50; Parsons, Kan., 35; Hyde Park, Ill., 50; Clinton, Mo., 50; Shelbyville, Mo. 50; Oshkosh, Wis., 50; Harrison, O., 35; Osage, Ia., 18; Farmville, Va., 30. Incandescent lights: Quincy, Ill., 1300; Monroe, Wis., 1300; Hoosac, Pa., 300; Mor-

ristown, Tenn., 650; White River Junction, Vt, 650; Arkadelphia, Kan., 650; Olathe, Kan., 650; Pella, Ia; 650; Waterville, Conn., 1300; Charleston, W. Va. 1300, Babylon, L. I., 650; Clinton, Mo., 500; Boston, Mass, 650; Chelsea, Mass, 1300; Harrison. O., 650; Huntington, Ind, 650; Port Huron, Mich., 1300; Tuscola, Ill., 500; Worcester, Mass., 1950; Paw Paw, Mich., 300; Edinburg, Ill, 300; Bennington, Vt., 1300; Omaha, Neb., 1300; New Albany, N. Y., 650; Greenville, Mich., 650; Virginia City, Nev., 650; Farmville, Va., 300; Mt. Vernon, N. Y, 1300; West Superior, Wis., 1300. Isolated plants, arc lights: Schlitz Brewing company, Chicago, Ill., 6; Alger, Smith & Co., Black River, Mich., 30; J. P. Craig, Memphis, Mo., 30; Glenwood Co, Yonkers, N. Y., 9; Sanderson & Sons, N. Y., 30; Central Iron Works, Harrisburg, Pa., 50; Bradner, Smith & Co., Chicago, Ill., 20; Woodcock & Loring, Chicago, Ill., 12; D. B. Fiske & Co., Chicago, Ill., 35 Isolated plants, incandescent lights: Warden Apartment house, Philadelphia, Pa., 1600; Tuscaroras Advertising Co., Cohocton, O., 100; Backus Wire Nail Co., Cleveland, O., 400; Road House, Chattanooga, Tenn., 600; Hotel Oglethorpe, Brunswick, Ga., 150; Deloach Mill Manufacturing Co., Atlanta, Ga., 100; National Distilling Co., Milwaukee, Wis., 100; St. Louis Railway Co., St. Louis, Mo., 200; A Zeese, Chicago, Ill., 100; Lane Bros., Newark. O., 150; C. E. Harwood, Lynn, Mass., 150; G. A. Robertson & Co., Hinsdale, N. H., 50; Brooks Bank Note and Lithographic Co, Boston, Mass., 100; Orr & Strettle, Pigua, O., 600; Piedmont Bath & Power Co., Oakland, Cal, 500; Fitchburg Mfg. Co., Fitchburg, Mass., 200; Calumet Distilling Co., New Chicago, Ill., 450; H. C. F. Koch, New York, N. Y., 1200; New York Jockey club, New York, N. Y., 800; Liss & Rickerman, Chicago, Ill., 100; D. B. Fiske & Co. Chicago, 250; Walter Aiken, Franklin Falls, N. Y., 100; Clark's hotel, Boston, Mass., 150; Monmouth Park hotel, Little Silver Station, N. Y,, 800; Wm. Ruehl Brewing Co., Chicago, Ill, 200; E. Richards & Son, Sandy Hill, N. Y., 100; Jordan & Stewart, Oldtown, Me., 50; Newmarket Mfg. Co., Newmarket, N. H., 400; E. P. Parksons & Co., Tilton, N. H., 200; American Scotch Iron Co., Syracuse, N. Y., 50; E. Frank Lewis, Lawrence, Mass., 100; American Tin & Lead Co., Canon City, Col., 200; Fairchild Paper Co., E. Pepperill, Mass,, 200; Gouverneur Wood Pulp Mfg. Co., Gouverneur, N. Y., 50; Lockport Pulp Co., Lockport, N. Y., 200; No. New York Marble Co., Gouverneur, N. Y., 50; Allen Bros. & Co., Sandy Hill, N. Y., 400; Walter M. Lowney, Boston, Mass., 200; Clarendon hotel, Brooklyn, N. Y., 400.

ELECTRIC MOTOR.

An electric street railway is to be built at Portland, Ore.

Electricity will be introduced by the Holyoke, Mass., Street Railway company.

Thirty-three electric street cars are now running regularly in Rochester, N. Y.

The Cedar Rapids, Ia., Street Railway company will change from animal to electric power.

The City Passenger Railway company of Altoona, Pa., has decided to use electricity as motive power.

Power for the new perfecting press of the Lancaster, Pa., *New Era*, is furnished by a Perret motor.

A 25-horse power motor has been put in by the Nashua, N. H., iron foundry. This will furnish the entire power for the works.

The Leadville, Colo., and Evergreeen Lakes Electric Railway company has been incorporated with a capital stock of$200,000.

Jackson, Mich, will have an electric railroad. Messrs. Corless & McMillan will build the road. The system has not yet been decided upon.

At Akron, O., the Akron Electrical Manufacturing company has been incorporated. It wi l manufacture motors, dynamos and general electrical supplies.

It is stated that the Electrical Engineering & Construction company has purchased the Bristol, Tenn., street railway and will change to electric power.

The Thomson-Houston Electric company has just closed a contract for 40 additional cars with the Cincinnati Street Railway company, and for 6 cars with the Pueblo, Colo., City Railway company.

The Wheeler Underground Electric company has been incorporated at Tacoma, Wash., capital stock $500'000. The company is composed of Western capitalists who announce their intention of pushing the system vigorously.

The work on the extension of the Nashville, Tenn, Electric street car lines has been greatly delayed by rainy weather. The bridge on the Citizens' Rapid Transit line has been completed, but it has been impossible to complete the embankments of the approaches.

The New York *Commercial Advertiser* will take possession of its new building on Park Row about April 5. Its presses will be run by electric motors. The Elektron Manufacturing company will instal a 20-horse power Perret motor to operate the Hoe presses.

The contract for the equipment for the North Chattanooga, Tenn., street railway has been awarded to the Westinghouse Electric company of Pittsburgh, Pa., and the contract for equipping the Chattanooga & Northside street railway to the Thomson-Houston company of Boston, Mass.

Sheep shearing by electric power is now in practical operation in Australia. An installation has just been made on the Raukapuka estate. Ten Wolseley machines are now electrically operated there, and it is calculated that the extra value of the clip of 13,000 sheep has nearly repaid in one season the whole cost of putting up the machines. In the Raukapuka plant, a turbine drives the dynamo, and an overhead wire conducts the current to the motor which drives the shafting in the wool shed.

The Santa Cruz, Cal., papers report that an electric road is projected from Garfield Park to Capitola. The capital stock, $100,000, has been subscribed.

The Maplewood Electric Railway company has been incorporated at Nashville, Tenn., by William M. Duncan, T. W. Crutcher, Jere Baxter, G. W: Ehler, Peter Tomble and L. K. Hart. Maplewood is the newly planned fashionable suburb on the east side, and about five miles from the center of Nashville.

During the recent snowstorm in Denver, Colo., there was not one cable line in operation, whi'e the Thomson-Houston electric cars were operated without the slightest difficulty. The Denver Tramway company has decided to abandon the Eighteenth street cable and use electricity as a means of car propulsion.

The Electric Merchandise company of Chicago last week secured an order for the complete overhead material for the Riverside Park Railway company of Sioux City, Ia. This company has prepared to construct eight miles of line at once. The Westinghouse slow speed motor, illustrated in a recent number of the WESTERN ELECTRICIAN will be used on this road.

The appearance of an electrical omnibus on the streets of London caused a sensation among the people passing along the streets, and drivers of cabs and other vehicles which the electric car is intended to displace. The carriage was in charge of Radcliffe Ward and contained stockholders of the company which will exploit the system. It is the intention of the company to establish a system of electrical omnibuses for regular passenger traffic.

The Thomson-Houston Electric company has just closed contracts with the Rock Creek railway, Washington, D. C., for 12 cars; Harrisburg City Passenger railway, Harrisburg, Pa., for 14 cars; City Electric railway, Little Rock, Ark., 28 cars; Jefferson Avenue railway, St. Louis, Mo, for 25 cars; Oxford Lake line, Armiston, Ala., 6 cars; Allentown & Bethlehem Rapid Transit company, Allentown, Pa., 15 cars; Marquette City & Presque Is'e company, Marquette, Mich., 3 cars; Braddock & Turtle Creek railway, Braddock, Pa., 3 cars; Salt Lake Rapid Transit company, Salt Lake City, Utah, 3 cars; Buffalo Street Railway company, Buffalo, N.Y., 12 cars; Pittsburg & Birmingham, 2 cars (making the fourth Thomson-Houston electric railway in Pittsburg, Pa.); Troy & Albia Street railway, Troy, N. Y., 20 cars; St. Louis & Suburban Street Railway company, St. Louis, Mo., 45 cars; Chattanooga & Northside railway, Chattanooga, Tenn., 4 cars.

NEW INCORPORATIONS.

H. A. Doty Light & Power company, Janesville, Wis.; capital stock, $30,000; general light and power business.

The Ashland Gas & Electric Light company, Ashland, O.; capital stock, $50,000; lighting by electricity and gas.

Denton Water, Light & Power company, Denton, Tex.; capital stock, $50,000; to supply light and power by electricity.

Montrose Electric company, Chicago, Ill; capital stock, $100,000; furnishing light, power and heat in Cook county, Ill.

Chicago Optical company, Chicago, Ill.; capital stock, $10,000; to manufacture, purchase and sell electrical and optical goods.

Keeseville Electric Light & Power company, Keeseville, N. Y.; capital stock, $40,000; the generation and sale of electricity for heat, light and power.

The Incandescent Light & Power company, Norwalk, O.; capital stock, $25,000; furnishing electric light, arc and incandescent, furnishing heat, power, etc.

The Lincoln Electric Street Railway company, Lincoln, Ill.; capital stock, $65,000; to build, operate and maintain an electric street railway in the city of Lincoln, Ill.

Electrical Engineering company, Omaha, Neb.; capital stock, $25,000; construction of lines of wire for transmission of electric currents for lighting and power purposes.

The Western Electric Storage Battery company, Kansas City, Kas.; capital stock $500,000; to erect, own and control and manufacture electrodes for storage batteries, etc.

The Universal Electric Manufacturing company, Chicago; capital stock, $20,000; for the manufacture of electrical inventions; incorporators, H. M. Day, J. Elliott and J. Usler.

Texarkana Light & Power company, Texarkana, Ark.; capital stock, $125,000; buying and operating a system of gas and electric lights and for transmitting power by electric motors.

Waco Electric Railway & Light company, Waco, Tex.; capital stock, $250,000; cons'ruction and maintenance of street railways and manufacture and supply light and heat by electricity and other means.

The Collingswood Water & Light company of Collingswood, N. J.; capital stock, $25,000; supplying water and light and power by electricity, gas or otherwise in the borough of Collingswood, N. J.

Subsurface Electric company, Portland, Me.; capital stock, $2,000,000; to manufaciure and deal in electrical apparatus of all kinds and to engage in the application of electricity to every kind of service.

The Riverside Electric Street Railway company, Riverside, O.; capital stock, $50,000; constructing, acquiring, operating and maintaining, leasing and owning, a street railway, to be operated by steam, horse, electricity, or other motive power.

The Northwestern Supply & Construction company: Jersey City, N. J.; capital stock $100,000; to build railroads, street railroads, waterworks, pipe lines, electric light plants and electric railroads, etc.

The Electric Supply & Contracting company, Cincinnati, O.; capital stock, $5,000; manufacturing, purchasing and selling electrical supplies and apparatus and all kinds of electrical and mechanical engineering work.

Electric Bul'etin company, Chicago; capital stock, $50,000; for the manufacture and operation of railway train annunciators and other devices for advertising; incorporators, F. A. Jennings, G. A. Cross and P. R. Jennings.

TELEPHONE.

It is said that there are at least twice, if not three times, as many telephones in use in the United States as in all other countries combined. It is estimated that there are in round numbers 525,000 telephone subscribers in this country, while a Berlin statistician places the number for all the rest of the world as not exceeding 200,000. In this estimate European nations are included as follows: Germany, 31,325; Great Britain, 20,426; Sweden, 12,864; France, 9,487; Italy, 9,183; Norway, 8,390; Russia, 7,585; Switzerland, 6,570; Belgium, 4,684; Austro-Hungary, 4,200; the Netherlands, 2,872; Spain, 2,218; Denmark, 1,838; Portugal, 890; total, 122,521.

TELEGRAPH.

In its review of the past year, the *Journal Telegraphique* gives the following figures: According to the latest statistics, the European telegraph administrations now place 353,400 miles of line and 1,023,000 miles of wire at the disposal of the public, an increase respectively of 4.6 per cent. and 3.1 per cent. upon previous returns. The increase in the number of telegraph offices has been very marked of late. In the seventh edition of the "Nomenclature des Bureaux," which appeared in 1887, 60,000 names were given, the eighth edition contains 75,000 names, or 25 per cent. more The number of telegrams transmitted also continues to increase. Last year 200,000,000 messages were dispatched in Europe, of which 45,000,000, or 22.5 per cent. were international.

PERSONAL.

S. A. Barton, president of the Brush Electric company, Cleveland, was in Chicago last week.

Norman McCarthy of the street railway department of the Thomson-Houston Electric company, Boston, has resigned.

TRADE NEWS.

The Elektron Manufacturing company of Brooklyn, calls attention to its Perret motor with self-adjusting bearing, and self-oiling bearings.

The Crocker-Wheeler Electric Motor company of New York has issued a handsome new catalogue showing its motors, electric fans and pumps.

Chas. A. Schieren & Co. of New York have issued an interesting pamphlet, neatly prepared, containing valuable information on perforated leather belts. There is a price list, numerous illustrations, a list of the electric plants using the belting of Schieren & Co., and numerous testimonials from those having experience with this company's goods.

R. B. Watson has resigned from his position as manager of the house goods department of the Detroit Electrical Works. Mr. Watson has been at the head of this department five years. He will open an electrical supply house on Franklin street, Detroit, and make a specialty of fine brass work. Mr. Watson carries with him to his new enterprise the best wishes of numerous friends.

The Stanley Electric Manufacturing company of Pittsfield, Mass., is in the field with the Stanley transformer adapted for the Westinghouse, Thompson-Houston, Fort Wayne and National systems. Strong claims are made for this transformer and the company expects to dispose of large quantities of them. Henry Hine, formerly connected with the United States and Westinghouse companies, is the general manager of the Stanley Electric Manufacturing company. Mr. Hine is popular and experienced and has the reputation of being successful in whatever he undertakes.

The Central Electric company, Chicago, has recently arranged with the Bryant company to handle its sockets and switches and already reports large sales. The company carries a complete stock of all sizes and capacities The orders for the improved Candee line wire, as recently received by the Central Electric company, have taxed its facilities to the utmost, and in consequence has tested the factory's capacity to keep a large stock of all sizes in anticipation of the spring business. The Central Electric company is about to place a new carbon battery upon the market.

C. R. Truex and W. A. Vail have opened an office at 44 Broadway, New York. They announce that they have formed a copartnership, and have secured the ex lusive selling agency in New York, New Jersey and adjacent territory for the Accumulator company of New York, the Electro Dynamo company of Philadelphia, and the Walker Electric company of New York. They will supply electrical accumulators, Edco motors, Edco switches, and Walker Electric meters. The new firm is also prepared, it says, to furnish electric supplies and do general construction work

BUSINESS.

The Easton Electric company has just sold another of its Claus-Easton dynamos or the improved Continental dynamo, to the Brooklyn Annex Ferry company.

Wilson, Reberstock & Co., manufacturers of electrical specialties, 174 Clark street, Chicago, have just placed in their factory several pieces of new machinery consisting of a lathe, drill press and stamp press, and have also installed an Edison motor of five-horse power capacity to furnish the necessary power.

The American Railway Equipment of New York and Chicago, are manufacturers agents for Eureka tempered copper goods for all purposes, for the western states and territories, and for railroad work throughout the United States. Their Chicago address is Phenix building and the New York office 15 Cortlandt street.

The Electric Merchandise company, Chicago, announces that it has been appointed selling agent for the Tramway Rail company, of Pittsburgh, Pa., manufacturer of steel rails of all descriptions, chairs, tie plate, splice bars, frogs, switchings, crossings, and other street railway equipment. Furthermore, it says: "It is not the intention of our company to try any experiments, but to follow well established principles, making all equipment strong and durable."

It is announced that arrangements have been completed by the directors of the Mt. Carmel Aeronautic Navigation company to begin work at once upon the large airship. The Exposition building at Chicago has been leased for three months, and the ship will be constructed in the north end of the edifice. A large quantity of aluminum has been ordered. Inventor Pennington promises that at the end of sixty days the ship will be ready and a thorough test in the open air will be made.

The new catalogue of the Crocker-Wheeler Electric Motor company, New York, contains much of interest concerning electric motors generally and the Crocker-Wheeler perfected motors in particular. A handsome illustration of one of these motors printed in several colors makes an attractive frontispiece to the catalogue, which throughout shows evidence of much care and attention. The text includes an interesting description of the construction of the Crocker-Wheeler motors, directions and suggestions for setting up and running them, and other valuable data regarding dimensions, horse-power, cost, etc. The construction and operation of a new and indestructible resistance box made entirely of slate and iron, for starting, stopping and regulating their motors is described in detail. The latter half of the catalogue is devoted to descriptions of the smaller motors, 1-6, 1-8 and 1-12 horse power, made by the company, and their numerous and useful applications. The text is well illustrated.

The Rodney Hunt Machine company, Orange, Mass., reports business unusually good for the time of the year. Among a large number of orders for water wheels are the following: Fort Wayne, Ind., Water Power company, 1,000 horse power; People's Electric Light & Power company, Oswego, N. Y., 500 horse power; Farmington River Light & Power company, Hartford, Conn., 650 horse power; Manchester Electric Light company, Manchester, N. H., 450 horse power; Electric Machine & Power company, Woonsocket, R. I., 175 horse power; Electric Construction company, Greenwich, N. Y., 300 horse power; Lebanon Electric Light company, Lebanon, N. H., 175 horse power; Gates Electric Light company, West Lebanon, N. H., 75 horse power; Gautemala, C. A, Electric Light company, 260 horse power; Nonotuck Silk Company Electric Power Plant, Leeds, Mass, 175 horse power; A. E Call, San Salvador, C. A., 100 horse power; Manufacturing Investment company, Madison, Me, electric plant, 75 horse power.

MISCELLANEOUS.

Carriages on the German state railways have been fitted with five six-candle power electric lamps each, and the system is to be thoroughly tested. The current is obtained from accumulators placed under each carriage. On the Swiss railways some trials have shown that a six-candle power incandescent lamp is equal to an ordinary oil lamp, and that one of ten candle power enables the smallest print to be read with ease. In this case the current was supplied by a dry battery, of eight elements and requiring to be recharged every eighteen hours, placed in a wooden box under the carriage.

There is a boom in property along the Housatonic river according to a dispatch from Ansonia, Conn. It is due to the discovery of mica on a farm. Pieces of mica six inches square and of very fine quality have been found in large quantities The experts pronounce it to be the clearest of any in New England. The surface ledge is over 1,000 feet long and turns downward. A company from Vermont which owns several mica mines has leased the ledge and has arranged to work it as early this spring as the weather permits. It is believed by those who have had experience in mica mining that the ledge is very valuable. Feldspar and silica are also found in paying quantities on the same farm, and these two minerals will be examined as soon as the frost leaves the ground.

Arthur Knight of the Edison company, Boston, in an interview spoke as follows in regard to the popularity of electrical work: There is a tremendous pressure everywhere by young men of education to get into the electrical business. The technical schools are turning them out by the hundreds. The electrical business is increasing more rapidly than any other trade or calling, and these young men are anxious to get in on the ground floor and rise with the rapid growth. As a rule, however, they have to begin at the very bottom, no matter how good their technical education. We send them out to do the manual labor of stringing wires, putting in lamps or working at the bench. Before a man can take a responsible place he must know the whole business practically from the bottom. Here the pay is small, but we are flooded with applications from those who are willing to work for little for the mere prospect of rising And it is true that almost all the officers in this and other electrical companies are young men. H. Ward Leonard of the Edison General Electric company graduated from the Massachusetts Institute of Technology a few years ago, went down to Brockton stringing wires, was sent out West selling plants in small towns, and so kept on until he rose to his present post. You can rarely find a middle aged man in the business. I recollect a few years ago a local electrical manufacturing concern filled an important office with a man who was business to his finger-tips, but was wofully ignorant regarding electricity. Well, he put out some circulars to the trade—got them up himself—and such a laugh went up everywhere on account of the bulls they contained that he had to give up his place. No; the electrical business wants young men in every department."

In the annual report to the Fire and Underwriters' association Chief Inspector McDevitt of Philadelphia says that there are over 5,000 buildings in Philadelphia in which electric currents are used for light and power purposes. Of this number 287 buildings have their own apparatus, varying in size from a 20-light installation to one of 4,000 lights. The number of lights furnished by these private plants aggregates 80,258 incandescent and 3,325 arc lights. There are fifteen central stations. The number of lights supplied by these stetions varies from 2,000 to over 40,000. The electric motors in use are of a capacity ranging from one-eighth to 30 horse power. The report concludes as follows: "No insurance loss occurred in any building in our city during the past year from fire where the cause could be in any way attributed to electric wires."

ELECTRICAL PATENTS.

Issued March 10, 1891.

447,767. Electric Arc Lamp. Henry C. Forgason, Oakland. Cal.

The object of this invention is to provide means whereby in a single lamp, when the carbons are exhausted, they will be brought into close contact, thus closing the arc, and when a double carbon lamp is employed the secondary pair of carbons will do the same.

447,768. Combined Annunciator and Telephone System. John C. Francis, New York, N. Y.

The object of the invention is to provide a combined annuciator and telephone system for use in hotels and other similar places in such a manner that the ordinary annunciator wires or circuits can be used without an expensive change to enable telephonic communication to be held between the office and the various rooms or apartments connected therewith.

447,788. Electric Switch. John M. Orford, Bridgeport, and John C. English, New Haven, Conn.

447,826. Electric Switch and Cut-out. William Hochhausen, Brooklyn, N. Y.

447,827. Electric Starting-switch. William Hochhausen, Brooklyn, N. Y.

447,832. Electric Light Fixture. Joseph Kintz, Ballardvale, Mass.

447,833. Coupling for Electric Wires. Climpson M. Knight and Thomas Hawken, Salem, Mass.

447,857. Galvanic Apparatus for the Human Body. Percy G. Williams, Brooklyn, N. Y.

447,858. Induction Preventive for Telephones. Thos. F Wright and Ed. G. Wilson, Chicago, Ill.

The first claim follows:

An induction preventive for telephones, comprising a hollow casing having perforations therein, a tube extending between said perforations, and a coil one end of which is embedded in a spool or block of wood or its equivalent and the other terminates opposite the center of a perforation in the casing opposing the diaphragm of a telephone-receiver to which the casing is secured.

447,861. Conduit for Electric Wiring in Building. Sigmund Bergmann, New York, N. Y.

447,867. Electric Switch. Horace T. Clark, Bridgeport, Conn.

447,869. Signal-Box. Frederick W. Cole, Newton, Mass.

447,885. Trolley Carriage and Conductor. Charles J. Luce, Niantic, Conn.

447,894. Electric Light Signal. Walter R. McCann and Simon S. Creider, Sterling, Ill.

447,896. Insulation of Electric Conductors. Frederick J. Nash, Brooklyn, N. Y.

The invention relates to means for insulating electric conducting wires or cables whether for aerial or underground use.

447,897. Electric Conductor. Frederick J. Nash, Brooklyn, N. Y.

This invention relates to means for insulating electric wires, and aims to provide a flexible covering of higher insulating value than any heretofore produced. It also aims to render the insulation flame proof, uninflammable, and as nearly fireproof as possible.

447,899. Elevator. Norton P. Otis, Yonkers, N. Y.

447,906. Electric Railway Signal. William W. Rosenfield, New York, N. Y.

The general object of this invention is to provide an improved electric railway signal system by which an alarm shall be given in the cab of a locomotive or at some other suitable part of the train as it enters upon a block in case a predetermined succeeding block be occupied by a train, whether stationary or moving in the same direction as the train in which the signal is given or in the opposite direction.

447,915. Current-Wheel. William Stephens, Santa Rosa, Cal.

447,918. Automatic Telephone Exchange. Almon B. Strowger, Kansas City, Mo.

The object of the invention is to provide means whereby a person at one station may make connection with any other station in the system by the aid of electrical appliances without the assistance of an operator at the central station.

447,920. Method of Operating Arc Lamps. Nikola Tesla, New York, N. Y.

447,921. Alternating Electric-Current Generator. Nikola Tesla, New York, N. Y.

447,939. Electric-Motor. William H. Chapman, Portland, Me.

The second claim reads:

"In a multipolar motor, a series of field magnet cores constructed and arranged in pairs, the two cores of each pair being composed of a series of plates placed one above another, and each forming a part of each core and being placed parallel to the axis of revolution of the armature, but removed from contact with the cores of the next magnet, and having their pole ends curved tangentially to a plane at right angles to the axis of revolution in both directions from the center of the width of each of said cores."

447,943. Railway-Car Telegraphy. William S. Cook and Moses C. Cook, South Omaha, Neb.

447,998. Electric Alarm. George W. Adams, Boston, Mass.

The invention relates to a system of protection by automatic electric alarms, part of the apparatus of which is located in the building sought to be protected, and part of the apparatus of which is located in a central office, the same being connected by electrical circuits to the apparatus in the building.

448,024. Telephone-Toll Apparatus. William Gray, Hartford, Conn.

448,031. Electric Railway Signaling Apparatus. Eugene L. Harrison, Crookston, Minn.

448,040. Commutator. William Hornberger, Elkhart, Ind.

The object of this invention is to prevent or greatly diminish the "sparking" common in machines between the brush and commutator sections, and to prevent or mitigate the destructive effect of the sparking upon the metal of which the commutator sections are composed.

448,044. Combined Push and Pull. Albert Iske, Lancaster, Pa.

448,084. Electrode for Arc Lamps. Albert C. Seibold, Mount Vernon, N. Y.

448,107. Electric Arc Lamp. La Motte C. Atwood, St. Louis, Mo.

The claim reads:

"In an electric arc lamp the combination of carbon-supporting rods, a motor, a train of gearing located between the motor and rods and containing an automatic clutch by which the gearing is thrown into and out of action, a magnet and armature, a spring actuated pivoted lever connected to said clutch, a pivoted bell-crank lever, a link connecting said levers, and a link connecting said bell-crank lever to said armature."

448,110. Electric Door-Opener. Louis Bates, Jersey City, N. J.

448,125. Train Order Annunciator. Leonard T. Crabtree, Oconto, Wis.

448,128. Body-Battery and Attachments for the Same. John A. Crisp and Geor e F. Webb, Jefferson, Ohio.

448,153. Apparatus for Intensifying Electrical Undulations. John C. Ludwig, San Francisco, Cal.

The last claim reads:

"9. In a telephone repeating instrument a telephone receiver, a local battery circuit having its poles terminating adjacent to the diaphragm, said circuit being completed by the electric undulations acting on said diaphragm, and one or more secondary circuits interposed between the line wire and the bobbin of the receiver and transmitter."

448,164. Device for Raising or Lowering Incandescent Electric Lamps. Charles F. Reinmann, Brooklyn, N. Y.

448,166. Automatic Switch-Board and Safety Cut-Out for Electric Circuits. Edgar A. Sweet, Milford, Mass.

The object of this invention is to provide a device for automatically short circuiting any one of a number of circuits connected in series for electric lighting, so that in case of accident to either circuit of the series from any cause, whereby it is rendered inoperative, said defective circuit will be automatically cut out or disconnected from the other circuits of the series, so that they will continue in the performance of their functions the same as if nothing had happened.

448,167. Switch for Incandescent Lamp Sockets. Alfred T. Tregurtha, Everett, Mass.

448,169. Polarized Annunciator. Ernest P. Warner Chicago, Ill.

The invention consists in providing, in connection with the poles of the electro magnet, a pivoted permanent magnet connected with the lever or catch which holds the shutter so arranged that current in one direction will cause the pivoted permanent magnet to turn upon its pivot and thereby lift the hook or detent to release the drop, while current in the opposite direction will only serve to hold the pivoted permanent magnet in position to more securely hold the said hooked lever in engagement with the drop to prevent the drop from falling.

448,172. Trolley for Electric Railways. Merle J. Wightman, Scranton, Pa.

448,173. Trolley for Electric Railways. Merle J. Wightman, Scranton, Pa.

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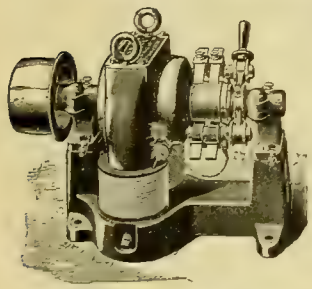

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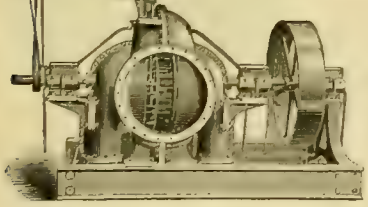

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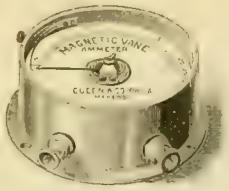

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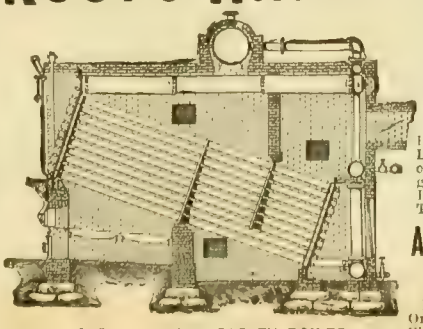

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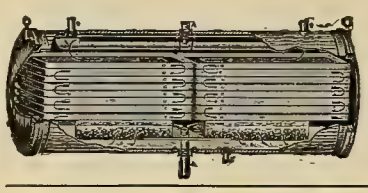

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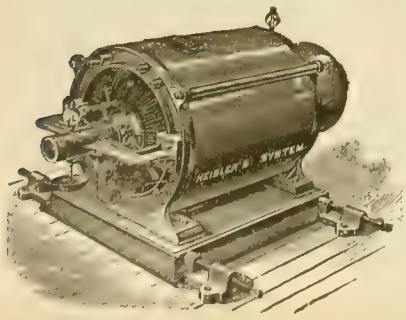

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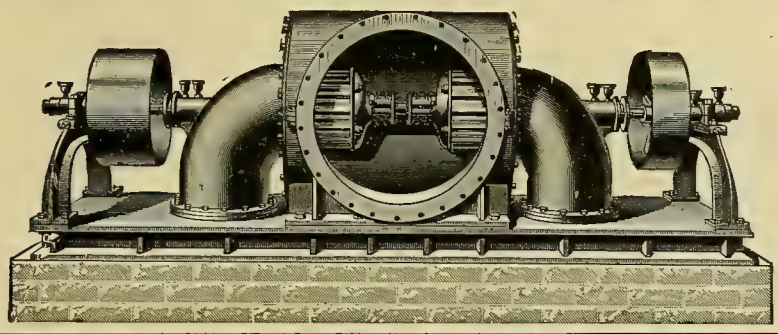

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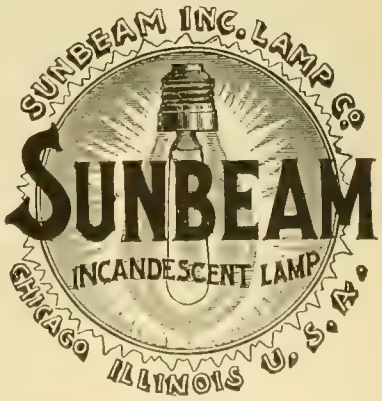

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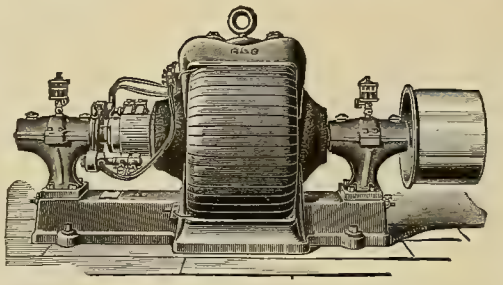

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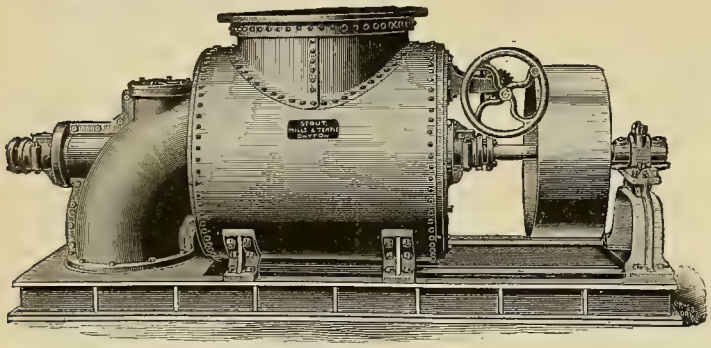

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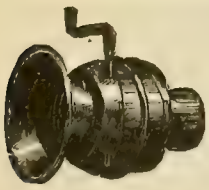

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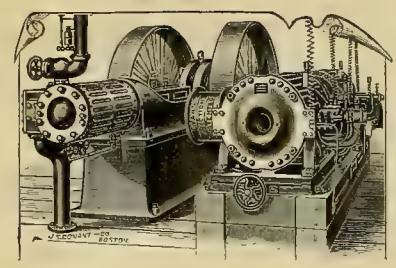

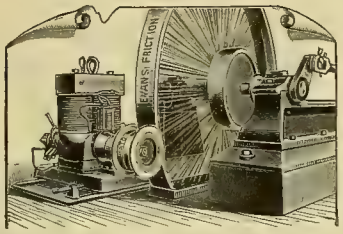

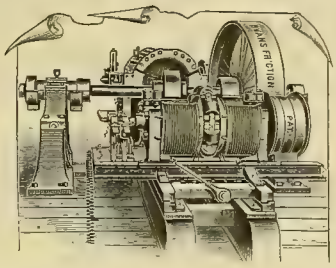

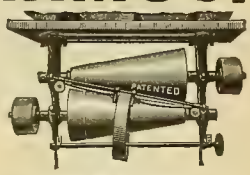

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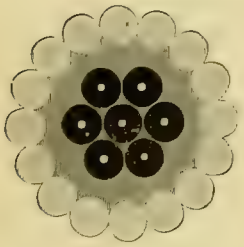

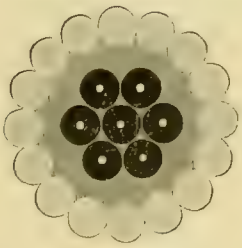

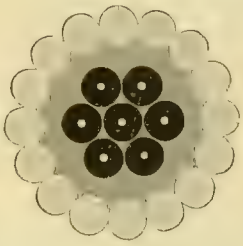

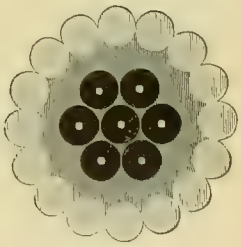

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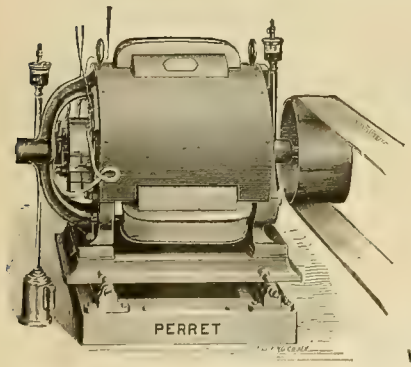

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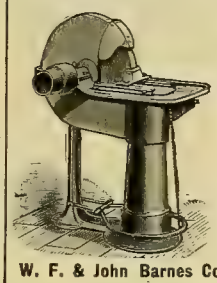

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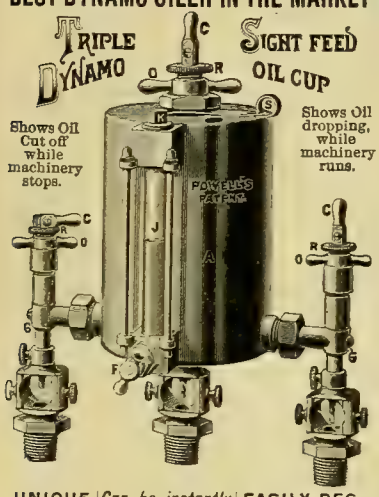

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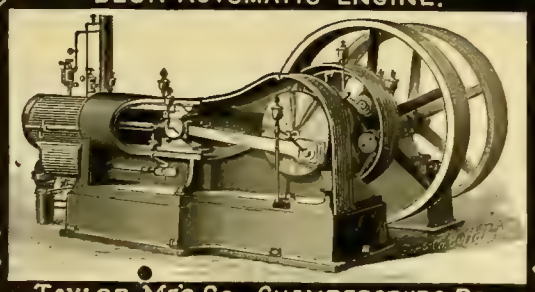

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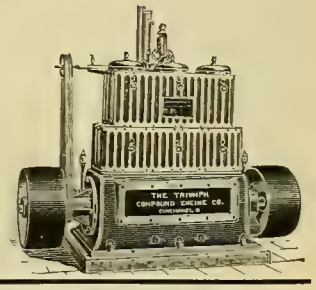

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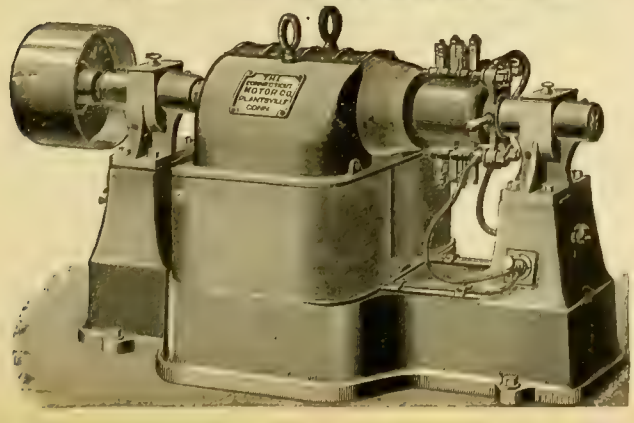

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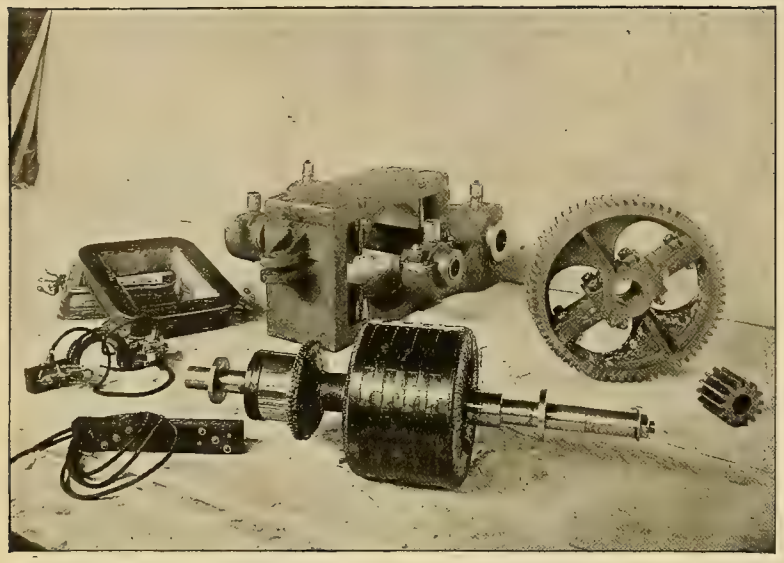

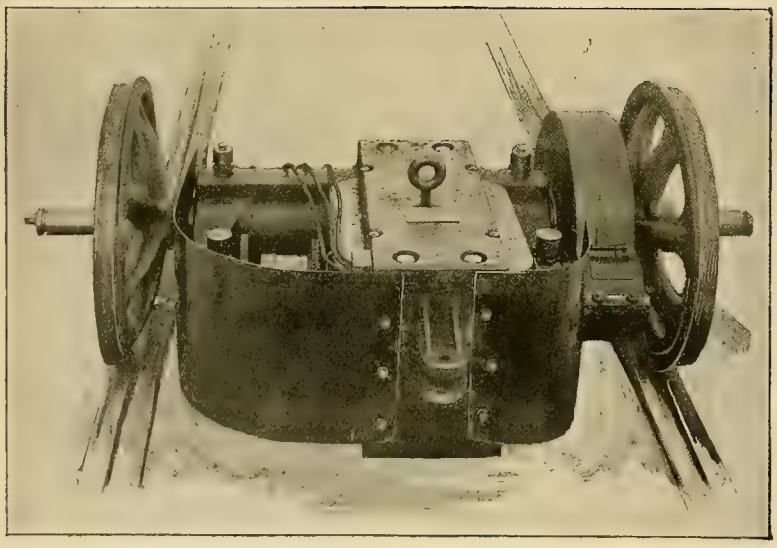

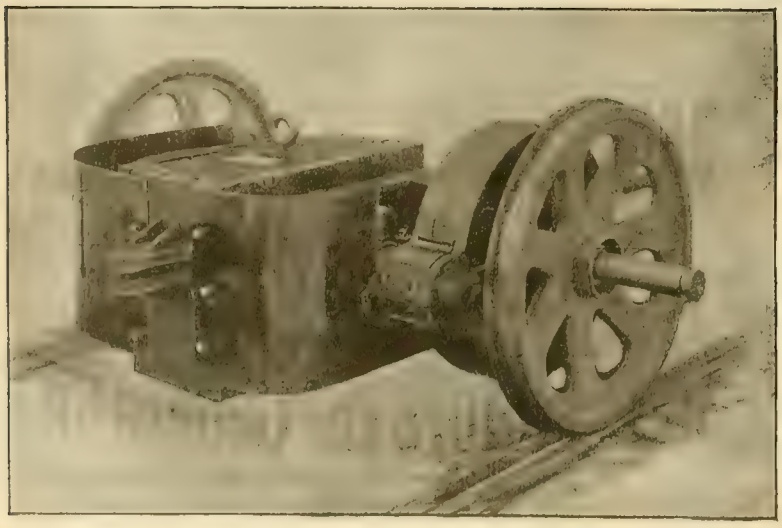

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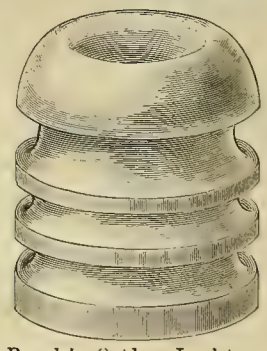

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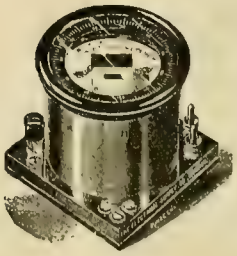

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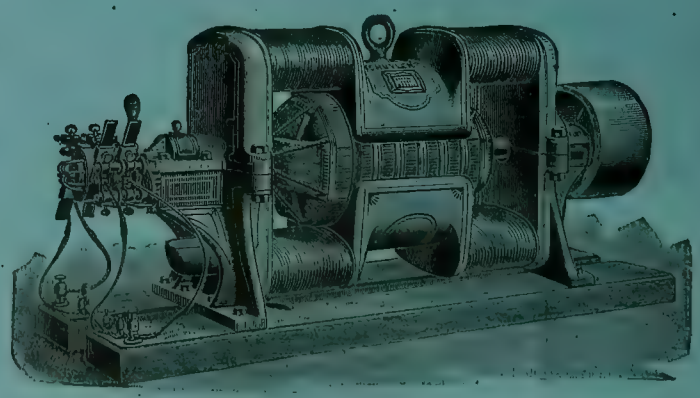

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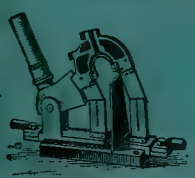

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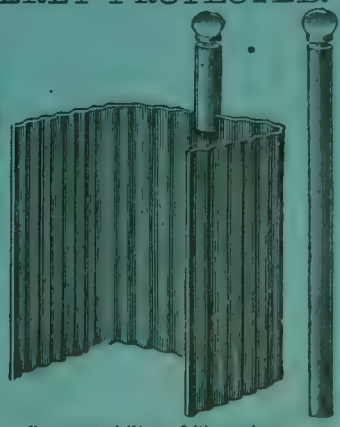

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Connecticut, - - -	37,477	22,450	60 per cent.
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115 North 3d Street, St. Louis, Mo.

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Magnolia Anti-Friction Metal Co., The.
Turner Brass Works.

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Brush Electric Co.
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Hawkeye Electric Mfg. Co.
McLaughlin, Jas.
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Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
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Crosby Electric Co.
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Leclanche Battery Co.
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Holtzer-Cabot Electric Co.
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Partrick & Carter Co.
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Southern Electrical Supply Co.
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Great Western Electric Supply Co.
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Edison General Electric Co.
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Holmes, Booth & Haydens.
Illinois Electric Material Co.
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International Okonite Co., The.
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St. Louis Electrical Supply Co.
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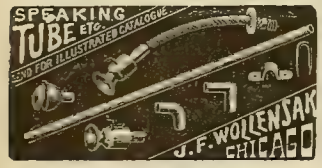

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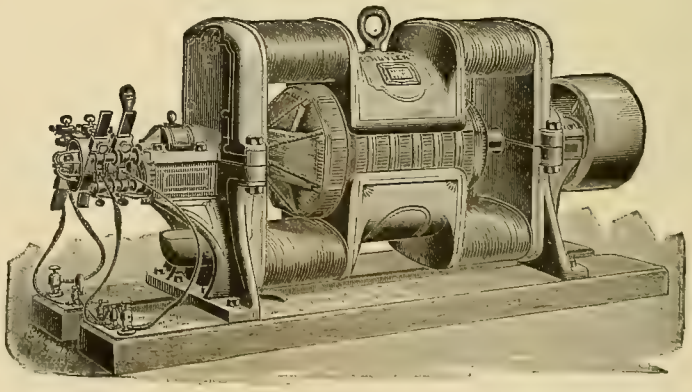

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LIGHTING SUPPLIES.

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A Full Line in Stock.

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625 in use on central station of Edison Electric Illuminating Co., Brooklyn, N. Y.

44 of these lamps are used in lighting the train sheds at the Grand Central Station, New York City.

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In Corresponding Please State Voltage and System.

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ORDERS FOR STANDARD POLES FILLED FROM STOCK.

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of *BOSTON*, many Stock Fire Insurance Companies which had been charging 2%, 3% and 4% even, have *MAGNANIMOUSLY* reduced their rates *A LITTLE*, and now their General Agent, Special Agent and Local Agent, and the Broker also are trying to get there first and tell you they "have reduced the rate." They are after their "commission" of 20% since the bars are let down.

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Our rates are about one-half the Stock rate and we will be able to pay one-half back in dividend, when policies are renewed. The *NEW ENGLAND FACTORY MUTUALS* work with us, and the cost of insurance in them is less than 30 cents a $100 per annum. The secret is, they have no agents, *PAY NO COMMISSIONS* and do business scientifically. They get no bad risks because every policyholder is a member of the Company and has a voice in its management.

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I am agent for Companies that insure Liability of Employers for injury to *ANY PERSON* employe or others, in the Station or outside, from electrical accident or others. Damage to property or injury to person by boiler explosion or rupture. Loss of income by stoppage of dynamos, in consequence of fire. Insurance on construction machinery and supplies from time of shipment, during transit, and until installation is accepted. Apply direct. *WE DON'T HAVE AGENTS.*

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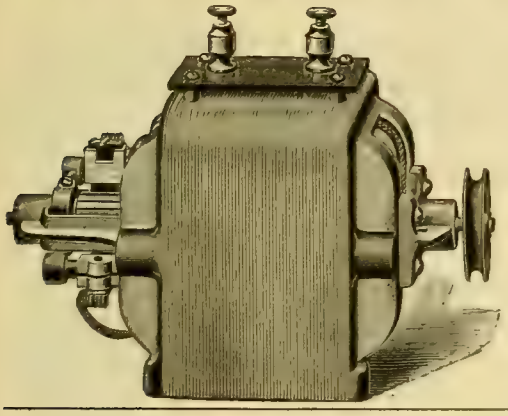

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Experts in applying Electricity to New Uses.

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Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

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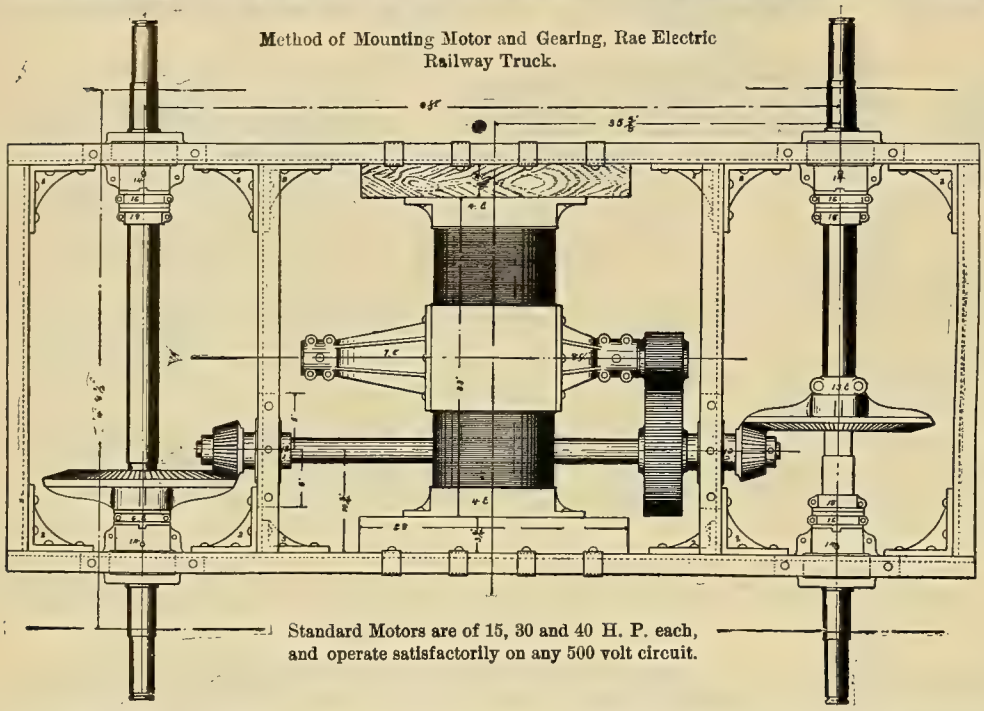
Method of Mounting Motor and Gearing, Rae Electric Railway Truck.



Standard Motors are of 15, 30 and 40 H. P. each, and operate satisfactorily on any 500 volt circuit.

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This is the only motor geared to both axles. It is designed and built for efficient and economical working. Its practical operation of street railways so far sustains this claim.

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THE RUBBER USED IN

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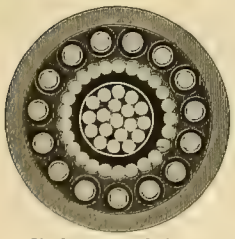
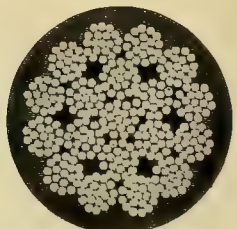
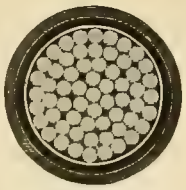


Underground Core.

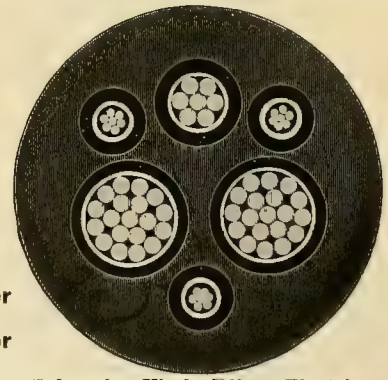


Feeder Cable, Brooklyn Edison Electric Light Co.

Underground Core, N. J. Central R. R.



Feeder Core, Broadway Theater.



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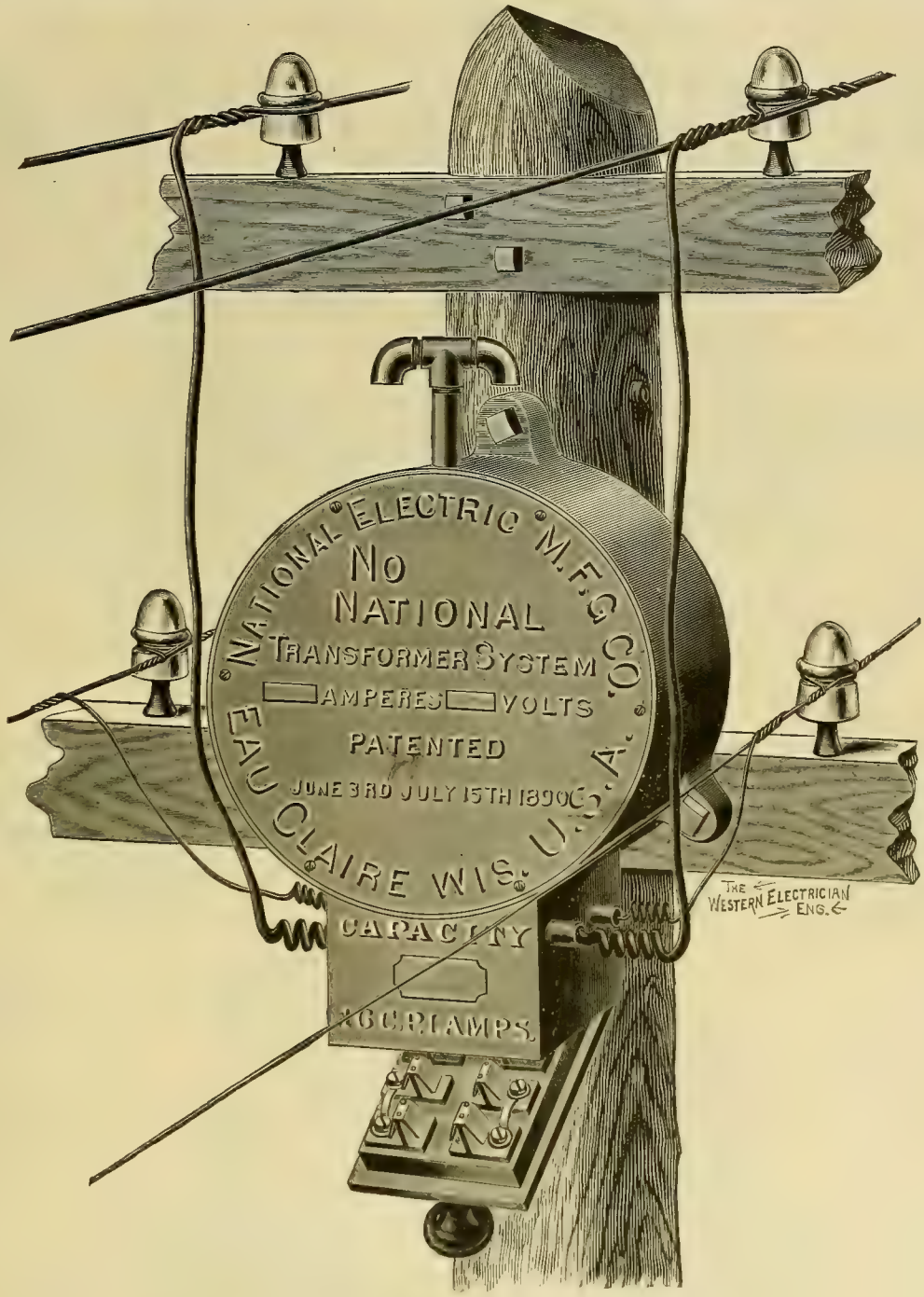
It Will PAY YOU to throw out your present transformers and substitute OUR MAKE.

No more Accidents from Grounded Circuits.



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They are the most efficient, {95.2%.} They are absolutely safe. Their regulation is practically perfect.

Transformer on Pole Showing National Safety Fuse Box.

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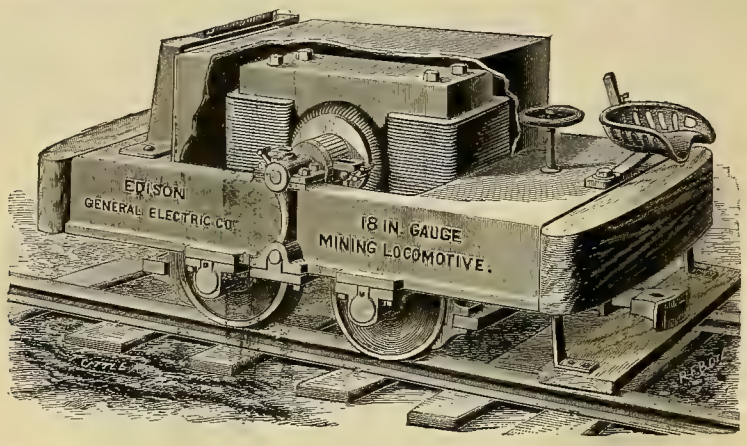

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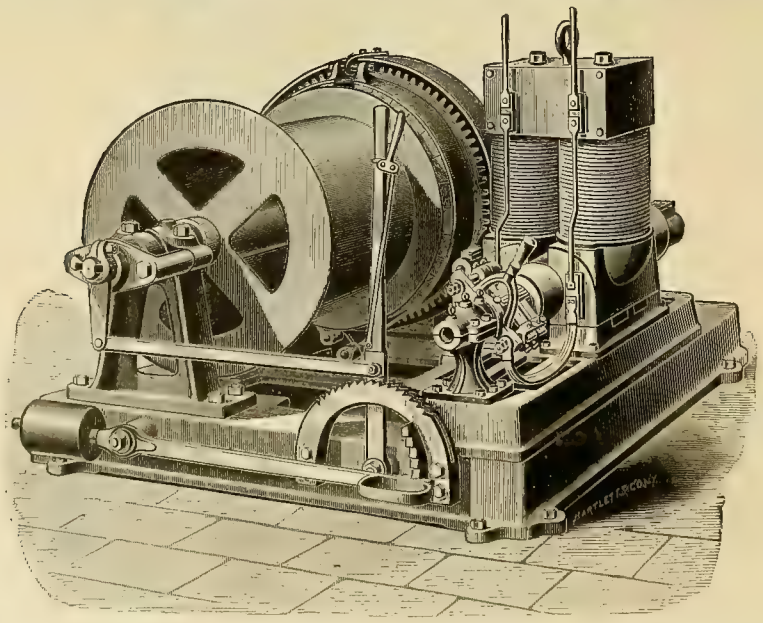

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Minimum of Wear.

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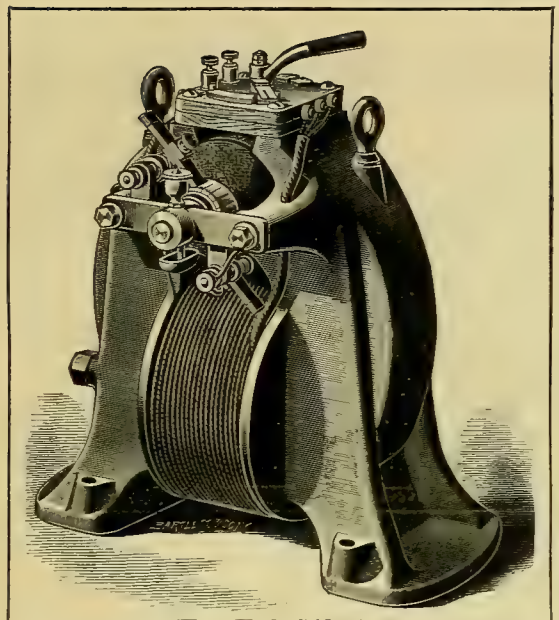

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MOTORS and GENERATORS

Direct Current GENERATORS and MOTORS for all purposes, 1-8 H. P. up to any power required, and at any required E. M. F.

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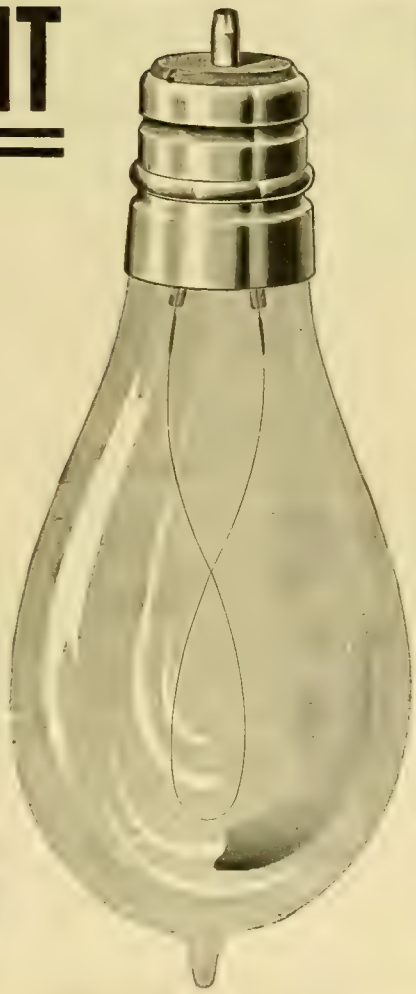

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FROM 8 c. p. to 150 c. p., AND ANY VOLTAGE.

Excelling all others in Life, Maintenance of Candle-Power and Efficiency.

Even Diffusion of Light by twisted filament.

THE BEST IS THE CHEAPEST.

General Electrical Supplies of Superior Designs and Finish.

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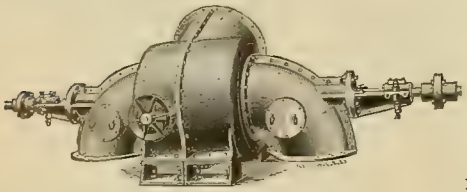
RODNEY HUNT MACHINE CO.,



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NO RING.

A SILENT CALL IS A GOOD THING SOMETIMES.

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Voltmeters and Ammeters.

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THE ONLY GOLD MEDAL AND DIPLOMA

AWARDED FOR A SYSTEM OF

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WAS GIVEN THE

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CEDAR, OCTAGONAL PINE AND STEEL.

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5 and 10 AMP. CAPACITY,

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FINE RESIDENCE INSTALLATIONS.

To see Them is to Like Them.

Tinted to match all Wall Papers.

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Western Electrician.

EVERY SATURDAY.

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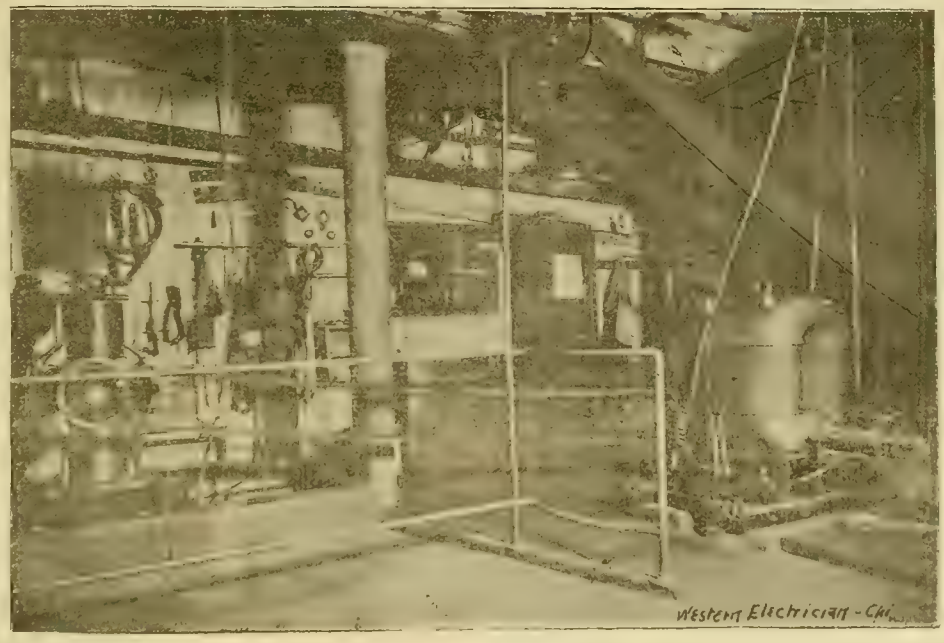
Novel Motor Installation.

The accompanying cut illustrates a novel motor installation at Thomson's restaurant, Chicago. It consists of a 20-horse power Eddy motor, operating an Excelsior arc dynamo. The current for the motor is supplied from the mains of the Chicago Edison company. From four to seventeen arc lamps are operated in the restaurant during the day. When it was decided to introduce electric lights in the establishment it was found that the engine capacity was not sufficient to furnish power at all times to drive the dynamo at the requisite speed. Current could be obtained from central station plants but only a flat rate could be secured, and that, of course, on the maximum number of lights. G. A. Edward Koehler, Chicago representative of the Eddy Electric Manufacturing company, suggested to the manager that he might secure economical results by installing a motor to operate an arc machine. This was accordingly done, the current required to operate the motor being supplied on the meter system. It is claimed that the average thus obtained is highly economical, and the service very efficient. The plant has now been running about six months and the steadiness of the light has been so marked even when a number of lamps were suddenly switched on or off, that the owner of the plant states that under no circumstances would he go back to the old method.



NOVEL MOTOR INSTALLATION.

Telephone Rates Discussed.

Last week the senate committee on labor and manufactures of the Illinois legislature considered Senator Thiele's bill to regulute telephone charges, reference to which has already been made in the WESTERN ELECTRICIAN. At the hearing the Chicago Telephone company was represented by C. H. Wilson, general superintendent; A. A. Thomas, attorney, and F. M. Buck, contractor. Superintendent H. H. Matlock appeared for the Central Union Telephone company. In his argument Mr. Thomas said that all legislation in regard to fixing telephone rates had met with total failure. He referred to the Indiana act, of which Mr. Thiele's bill is a copy, and showed that under its provisions the companies in that state were forced to go out of business, and that the repeal of the law was demanded by those who were the most active in urging its passage. He referred to the fact that this matter had been investigated by the legislatures of Maine, New Hampshire, Massachusetts, Connecticut, Pennsylvania, Ohio, Michigan, and several other states, which in each instance had refused to do what is advocated by Senator Thiele. Mr. Wilson explained to the committee the manner of conducting the Chicago exchange, the enormous expense of the service and the large amount of money being expended for underground wires. The bill was referred to a subcommittee.

Lighting Railroad Tunnels.

The people of New York are evidently in earnest in their demand that railroad tunnels shall be properly lighted. The railroad officials say that in addition to the cost of installing an electric plant for this purpose there are other objections—arc lamps would "dazzle" the engineers and incandescent lamps would not be seen through the smoke and soot. The newspapers are making a hard fight for the introduction of electricity. The incandescent lamps in the Hoosac tunnel make it the safest bit of the road on a dark night. There are no sickening fumes from the soft coal of the engines, and fog and smoke are blown out by the ventilating apparatus The problem confronting the managers of the Fourth avenue tunnel is pronounced simplicity itself when compared with that which the Fitchburg railroad of the State of Massachusetts has met and overcome. In the first place, the burning of soft coal in the tunnel should be forbidden. This smoke and gas and dirt creating nuisance should be abolished. In the second place, experience in the Hoosac tunnel has demonstrated that the tunnel may be easily ventilated and lighted, and that such a collision as that which recently happened may be made absolutely inexcusable. Despite the example of the Hoosac tunnel, the railroad officials maintain that they cannot light the tunnels by electricity. Supt. Toucey of the New York Central railroad appeared before the aldermanic railroad committee to oppose the adoption of the resolution compelling the company to light the Fourth avenue tunnel by electricity or other means. No one, he said, could be more anxious than the officers of the railroad company to render the tunnel safe. He had been studying the problem for years, had examined the lighting of the Hoosac tunnel and had figured on the cost of an electric light plant for the Fourth avenue tunnel. The plant would cost about $62,000 and it would cost $6,000 a year to operate. But he had come to the conclusion that electric lights would not answer the purpose. The arc lights would be worse than total darkness, he said, owing to the dazzling and confusing glare cast by them, and, with the condensation of steam in the tunnel and the gathering of soot, the little incandescent lamps would soon be so coated that they would give out no more light than so many fireflies. The lights were used in the Hoosac tunnel, he said, for the benefit of the track-walkers, not for the engineers. The use of anthracite coal in the tunnel, Mr. Toucey argued, would prove a greater annoyance than the use of soft coal because of the flying cinders and slate dust. The engineers had positive orders to "bank" their fires and not to put on fresh coal between Ninety-ninth street and the Grand Central depot.

A reporter testified that he had inspected the lighting of the Hoosac tunnel, and described how it was done. Electric lights were placed forty feet apart. There were 1,250 of these lights, and the tunnel was as bright as day. Engineers used only coke in the tunnel consequently the atmosphere was not obscured. The tunnel had an upward grade of twenty-six feet to the mile from either end, and at the apex in the middle there was a shaft extending 1,028 feet to the surface, which drew off all impurities in the atmosphere of the tunnel. Engineers who used the tunnel told the witness that, while the company had fought against the system at first, it was now admitted to be perfect. No accident had happened since it had been put in. The cost of maintenance was about $30 a day.

Municipal Ownership.

The electric lighting companies, the telephone and telegraph, and in fact all electrical interests of Illinois, will be interested in the following named committee of the state legislature: Municipal corporation—Representatives Smith of Livingston, chairman; Green, Lyman of Cook, Farrell, Dixon of Lee, Townsend, Dawdy, O'Donnell, Van Praag, Kern, Burke, Haynes, Wren of Cook, Miller, Nohe, Morris, Hutchings, Callahan, McCrone, Brown.

One of the most important subjects proposed for the consideration of the Illinois statesmen will be the municipal ownership of electric light, gas and street car plants. The committee named will probably prepare a bill or rather take the responsibility for introducing a measure prepared by some one who desires to make political capital out of the matter.

Short's Gearless Railway Motor.

In the accompanying cuts is represented the latest type of railway motor constructed by the Short Electric Railway company of Cleveland, O. All gearing has been eliminated from this motor. It is placed directly upon the car axle and makes 100 to 150 revolutions per minute.

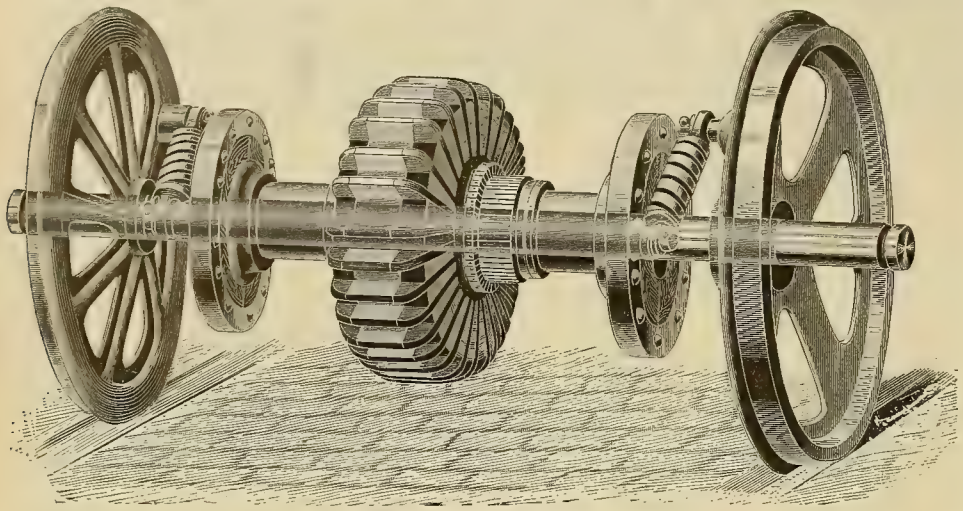


FIG. 1. SHORT'S GEARLESS RAILWAY MOTOR.

Referring to the accompanying illustrations, Fig. 1 shows a pair of wheels with their axle running through the hollow armature shaft of the gearless motor. This hollow shaft is made of steel, and is about six inches in diameter on the outside with an opening inside of nearly five inches, so that there is a clearance between the axle of the car and the inside of this hollow shaft of an inch air space all around. In the center of this shaft the armature and the commutator are fastened, and on each end of the armature shaft is keyed two heavy crank disks made with an iron hub and rim, and a wooden web similar to the gears which have heretofore been used by that company. This thoroughly insulates the armature shaft from the rim of the crank wheel. This crank wheel rim has upon one side a crank pin, as will be seen in the illustration. The car wheel has a crank pin also, and between the two is stretched a heavy coil spring, capable of pulling with a very slight elongation 2,500 or 3,000 pounds. The power of the motor in turning the wheel is transmitted through these springs, and the wheel is readily turned in the direction in which the armature tends to rotate. Just inside of the crank disks are the bearings of the hollow armature shaft in the motor frame. By referring to Fig. 2 it will be seen that this motor frame is made of two peculiarly shaped castings of steel with arms projecting forward and backward. These arms rest on rubber cushions placed on channel bars which go from side to side of the motor frame. In this way the armature is held up in the frame and away from the axle, and the entire weight of the motor is supported by these spring cushions and by the car boxes outside of the wheels at the points where the car body is supported. None of the weight of the motor falls on the axle inside of the wheels. The spring cushions upon which the motor frame rests are limited in their movements to a fixed distance so that the inside of the armature shaft cannot come down upon the axle. By these means the motor is carried entirely on springs.

Difficulty has heretofore been experienced from the crystallization and breaking of the motor frame. It is expected this will be entirely overcome by the use of the spring cushions under the gearless motor.

Another line of difficulties inherent in high speed motors is overcome by the slow speed of the gearless machine. Two bearings only are needed and as those are large and located in the motor frame it is expected the wear will be very slow. The commutator runs slowly and does not heat perceptibly. As the centrifugal force is exceedingly small, a high rate of speed in the car can do no damage to the motor. As far as a tendency to burst the commutator or throw the bobbins on the armature out of place goes, a speed to the car of 25 or 30 miles per hour will mean no more to the gearless motor, it is claimed, than a speed of 8 or 10 miles to the high speed ordinary motor.

Fig. 3 shows a view of the motor at the end looking through the spokes of the wheel, and gives a good idea of the simplicity of construction and shows very clearly the spring supports of the motor frame.

Fig. 2 shows a motor complete on the axle with the sheet-iron casing covering the entire machine. This casing supersedes the dust-pans and side curtains, gear boxes and other devices for protecting machinery under a car from mud and water.

It is a quarter of an inch thick and is made of boiler iron hinged on each side at the top and open in the center at the bottom, where it is held together with a latch fastening. When a car is run over the pit the casing can be opened out and the motor examined from below. The upper part of the casing is open about a foot in width next to the car floor in order to provide good ventilation.

When it is necessary to repair one of these motors four bolts are removed, and the lower half of the casing is dropped into the pit. The armature axle wheels are then free, and the car body can be jacked up, carrying with it the upper portion of the motor train, and the field magnets, the armature and the wheels can be rolled out and another set put in their place. The motor is not taken to pieces in doing this, and the matter of handling the armature is much simplified since one man can make the change.

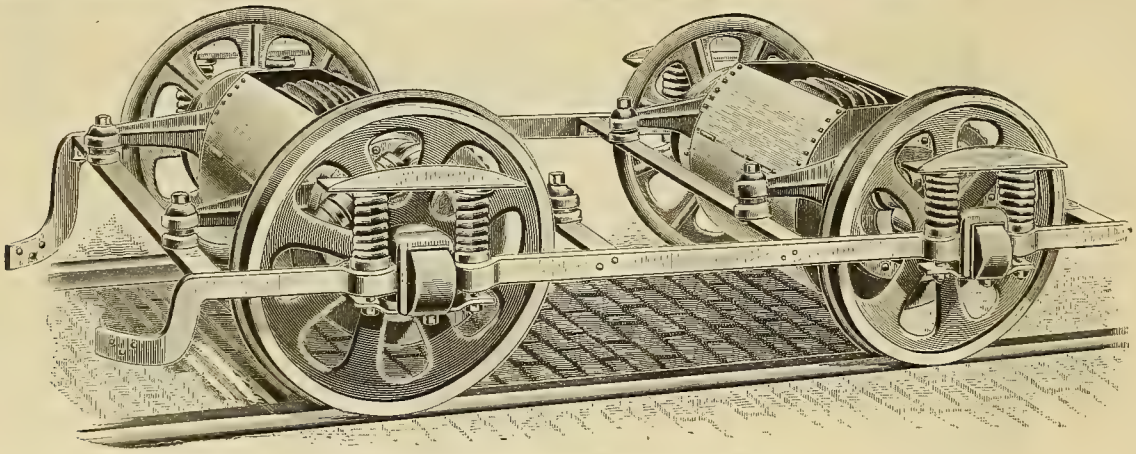


FIG. 4. SHORT'S GEARLESS RAILWAY MOTOR.

Fig. 4 shows the truck fitted up with two of these gearless motors. The space between the wheels—entirely filled up with apparatus where the old type geared motor is used—is with these new motors open and clear. Cars equipped with the gearless motors look like the ordinary horse cars, and, it is claimed, make no more noise than the horse car in passing along the track. As the motor is smaller than the diameter of the car wheels it is

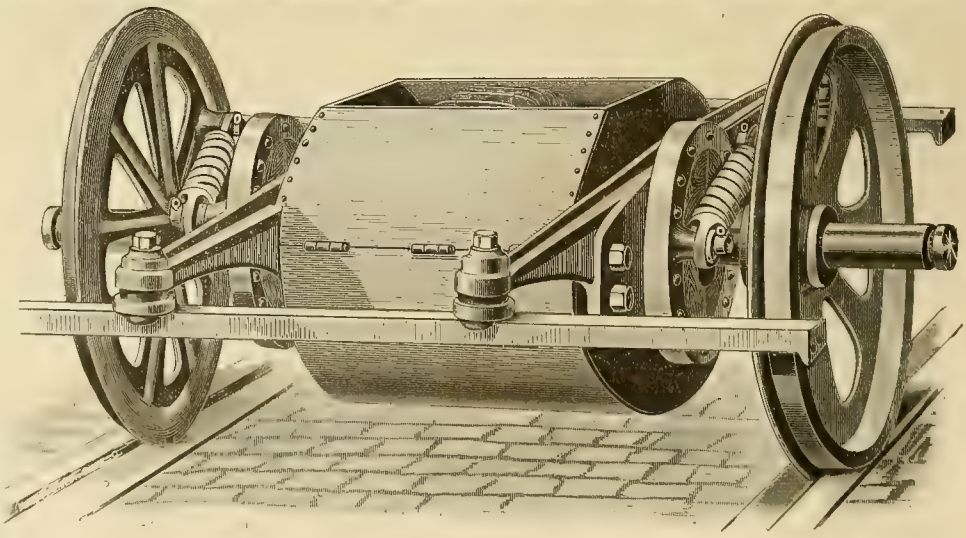


FIG. 2. SHORT'S GEARLESS RAILWAY MOTOR.

not easily seen and must be looked for very closely. The motor is constructed entirely of wrought iron and steel, the parts, as will be seen, being very heavy and strong, giving a safety factor of many times the requirements of the motor. The rheostat and controlling mechanism used with the standard motor are applied to this machine, and as any slight jerk which might occur in first throwing on the current is taken up by the coil springs between the crank disks and the wheels, the car starts easily and smoothly.

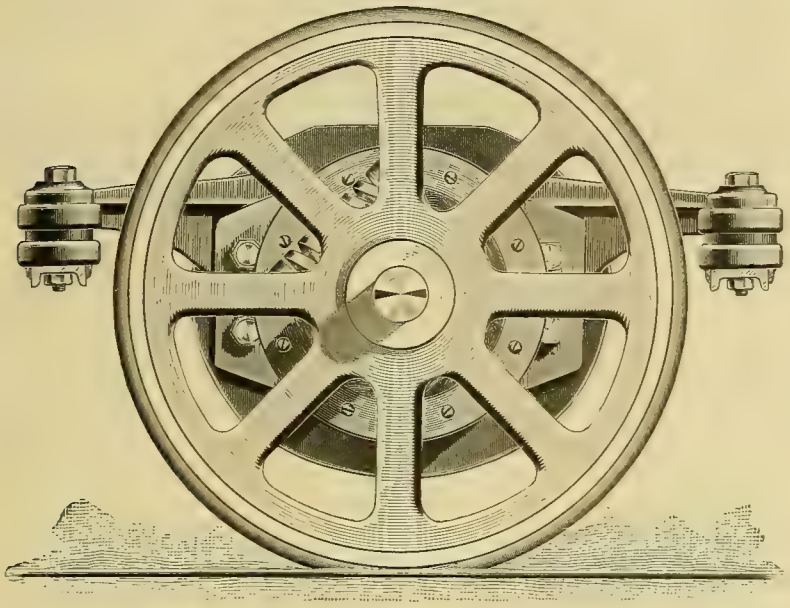


FIG. 3. SHORT'S GEARLESS RAILWAY MOTOR.

The humming and fretting sounds caused by the brushes in contact with the commutator are materially lessened by the slow speed of the armature, and as both commutator and brushes are inside the casing they cannot be injured by mud and water.

The weight of the new motor is practically the same as that of the standard motor made by the same company, and its efficiency is somewhat greater, especially at normal loads from 5 to 10 horse power, where a motor usually runs.

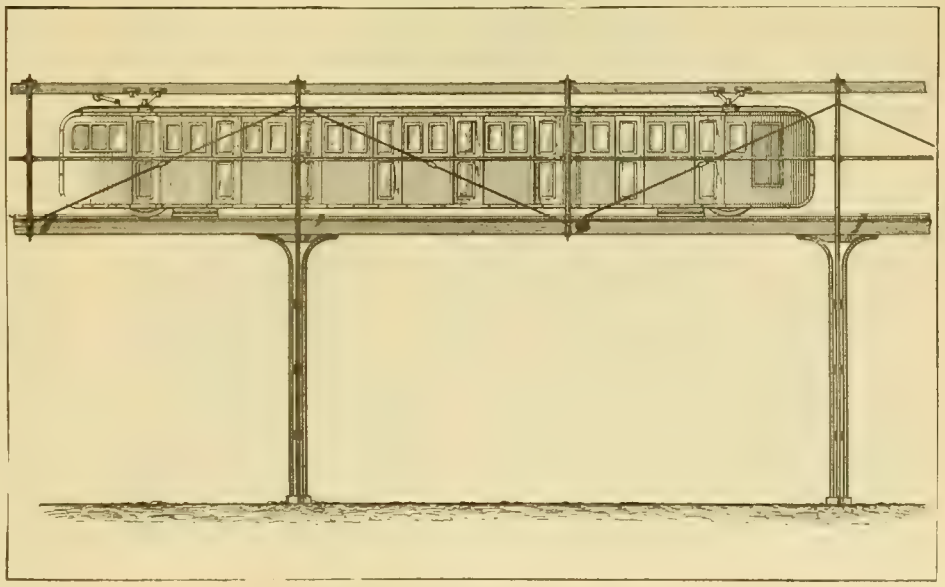
Wirt Volt Indicator.

In the accompanying cut is illustrated the Wirt volt indicator which the Electrical Supply company of Chicago has just placed upon the market. It is the result of extensive tests and experiments, and is said to be an instrument of unusual accuracy. It is claimed for this device that it is strong and substantial, containing but one moving part, and not liable to injury in shipping or in use. The indicator has a case of cast iron with glass front and brass rim, thus guarding against moisture, heat and dirt. The principle of action is that of magnetic attraction with gravity control, "magnetic memory" being practically eliminated by the methods of design and construction. A new alloy, not yet made public, but which is said to have great permanency of resistance and a remarkably small temperature variation, forms the chief part of the resistance. Attention is called to the fact that no gears or springs are employed in this instrument; no multiplying device; no hot wires or pulleys; no uncertain carbon resistance. The scale is direct reading, and a movable index permits the deflection to be read at a distance of twenty feet, it is claimed, and a deviation of ½ to 1 per cent. is easily perceived.

WIRT VOLT INDICATOR.

The Boynton Bicycle Electric Railway System.

Among the many electric railway systems that will be shown at the World's Fair the Boynton electric bicycle car will no doubt attract attention. In this system the principle of the bicycle is adopted for railway transportation. The cars are supported on a single rail, which is upheld by an elevated superstructure. Lateral support to the cars is given by an overhead rail, against which guide wheels press, thus preventing the car from swaying from side to side. Either steam or electricity can be used as motive power. When the latter agent is employed the appearance of the car is indicated in the cut.



THE BOYNTON BICYCLE ELECTRIC RAILWAY SYSTEM.

An important feature of the system is the overhead guide for the trolley wire. The conductor is imbedded in the guide, surrounded on all sides, except the lower, with insulating material. Contact with the trolley is made through the narrow slot at the bottom of the guide.

The conductor is protected from climatic changes, and is kept dry and clean. The conductor has a continuous support, and is always parallel with the supporting rail. A safe contact under high rates of speed is insured, it is claimed, and as the guide beam holding the conductor is readily bent to conform to the curves, all difficulty in forming or rounding curves is eliminated. The slot in the guide-beam forms a moderately deep groove, making it extremely difficult for the trolley to get out or to leave the conductor. Another advantage is the proximity of the car top and upper guide, which necessitates only a very short trolley arm. A much higher voltage than that now used in electric railway work will be employed.

ELECTRIC CIGAR LIGHTER.

It is claimed that the bicycle cars will run so easily that a speed of 200 miles an hour is feasible. The weight of the car and motor combined is only five tons.

Electric Cigar Lighter.

The accompanying cut illustrates a new electric cigar lighter manufactured by the Crosby Electric company. It consists of either a single or double bronze figure placed on a pedestal containing three of the long distance telephone dry batteries, which give the current for the lighter.

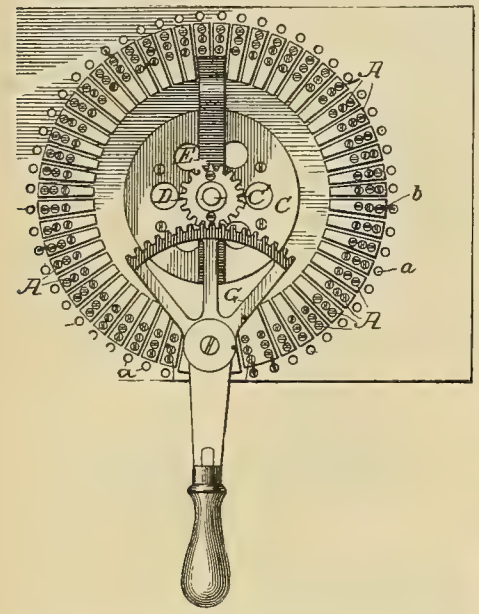
Telephone Legislation in Wisconsin.

The question of imposing a tax on the telephone companies of Wisconsin has been under discussion in the legislature for some time. In the senate last week a bill providing for requiring a license of 2½ per cent of the gross earnings was proposed.

The South Orange company of Newark, N. J., has let a contract for the equipping of its street railway with the Edison system. The old cars will be rebuilt, and the entire change will involve an expense of $300,000.

Segmental Resistance Board for Theaters.

The rapidly increasing demand for electric lighting in securing effects in theaters has created a demand for many special devices. In the accompanying cut is represented a segmental resistance board devised by G. D. Hand and O. P. Sells of Chicago, for regulating incandescent lights in theaters, halls, and public places, so that the lights may be lowered or raised gradually or instantly. In the illustration *A* represents a



SEGMENTAL RESISTANCE BOARD FOR THEATERS.

series of segmental contact-plates, each of which is connected to a resistance-coil. The plates are arranged in a circle upon a wooden board or plate of insulating material, provided with a series of holes *a a*, through which the plates and coils are connected. A circular formed plate *C* surrounded by the smaller plates is attached to the board. Upon its center is a pivotal stud and upon this is journaled a pinion *D*, the boss of which extends downward slightly and is connected with the brush *E*. This brush has the end of its longer arm bearing down upon the inner portion of at least two of the plates *A* all the time, and the end of its shorter arm bears down upon the circular plate *C* at a point preferably diametrically opposite its other end. The coil connected to the middle plate has the greatest resistance and each plate in succession moving from left to right has less resistance than the one preceding until a plate is reached, which has no resistance. The operation of the device will be readily understood. The brush *E* may be revolved over the plates *A* in either direction, by meshing with the pinion *D* the segmental gear *G* pivoted upon a stud projecting from a block, and this block is secured to the board in circular alignment with plates *A*. This segmental gear is oscillated by means of a handle, projecting from the boss of the gear, a root projecting downward from the center of plate *C*. This root has tapped into the end of it a binding-screw, which serves to connect the board with the positive pole of the generator, and by means of a suitable washer keep the root, plate, and post in position. From these parts the current passes through the brush *E*, through the segment-plates *A* to the resistance-coils, and by means of a union-wire they are connected to the plate. From this plate the circuit passes to and through the lamp system, back to the negative pole of the generator. When the brush is upon the plate, the current passes direct to the lamp system.

During the last two years the work of equipping the Salt Lake City railways with electricity has been progressing rapidly, and to-day the city has 65 miles of road operated by electricity. The Salt Lake City railway has 32 miles and 40 cars in its system. There are two more companies, the Rapid Transit and Great Salt Lake, and three new ones not yet in operation, the West Side Rapid Transit, the Beck Hot Springs railway, and the East Beach railway.

Electric Motor Truck.

Francis O. Blackwell of New York, has designed an electric motor truck, which is independent of the car body. It is illustrated in the accompanying cuts. In Fig. 1 is shown a side elevation and a plan of the truck with the axle box removed. Figs. 2 and 3 are respectively a side elevation and plan of an improved motor-frame having an arrangement of gears especially adapted for the connection of electric motors with the axles of trucks or other vehicles.

It will be seen by reference to the illustrations that there is an arrangement of devices rigidly connecting the motor to the axle of the car by bearings, so as to permit the accurate engagement of the gears and forming a driving-connection between the armature of the motor and the axle. The outer extremity of the motor is supported upon a frame attached to the ordinary journal boxes of the car outside the wheels, and has a yielding connection which relieves the axle of the pounding action of the motor.

In the cuts, *A* represents an electric motor connected through gearing *B* with the axle *C* of a truck, while *DD* are rigid bearings extending from the framework of the motor and maintaining the alignment of the armature-shaft and countershaft with the axle, so that the gearing *B* may run accurately. The outer end of motor *A* is supported upon a frame work consisting of side bars, which are attached to

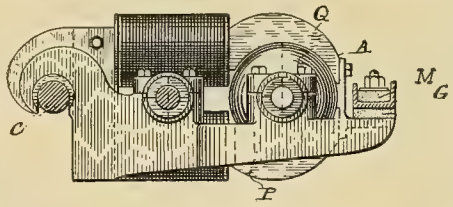


FIG. 2. ELECTRIC MOTOR TRUCK.

the journal boxes *F* of the truck, placed in the ordinary manner outside of the wheels. The side bars are connected by a transverse bar or board *G* outside the axle, and also by diagonal pieces *HH*, forming a guard for the motor and for the prevention of accident. The outer end of motor *A* rests upon transverse piece *G* and the side bars are attached to the journal boxes at a point below the springs *K*, which supports the car body. To diminish the pounding effect of the motor or motors upon the axles, the side bars are provided with a cushion, which modifies the force of the jars and shocks to which the truck is exposed. The cushioning action may be secured, when the bars *E* extend directly from journal box to journal box, by providing them with a rubber or other spring, as at *M*, Fig 2, at the point of attachment to the boxes, or, as shown in Fig. 1, where two motors are employed driving the respective axles, by dividing the truck frame into two parts, as it were, each of which is attached directly to one of the axles, and by securing the bars together by bolts and rubber cushions, as shown at *M*, Fig. 1.

The framing of the motor, by which it is connected to the axle, is so shaped that the

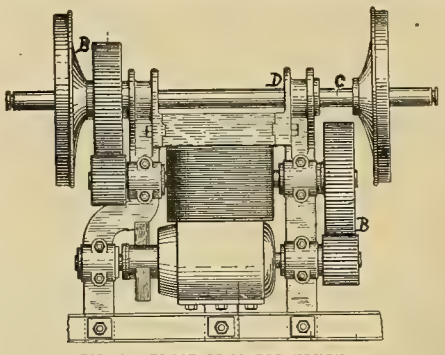


FIG. 3. ELECTRIC MOTOR TRUCK.

intermediate shaft may have a gear wheel at opposite ends instead of having all the gearing concentrated at one end. By this means it is claimed a more direct action of the armature upon the axle is insured, the pressure being more uniformly balanced and the connection between the bearings of each of the engaging wheels more direct. This arrangement also allows of more lateral room, so that a sprocket-wheel or other connecting device between the two axles may be employed. It will be observed that in this arrangement the pinions upon the armature shaft and the intermediate shaft are all the same size, and the same is true of the gear wheels upon the intermediate shaft and the axle.

This is done in order that the pinions on the armature shaft may be a duplicate of the intermediate pinion. It will be seen from the side elevation that the arm of the side frame extends outward from the axle at a much lower elevation than in ordinary practice, and that the bearing for the armature shaft is elevated above the side arm.

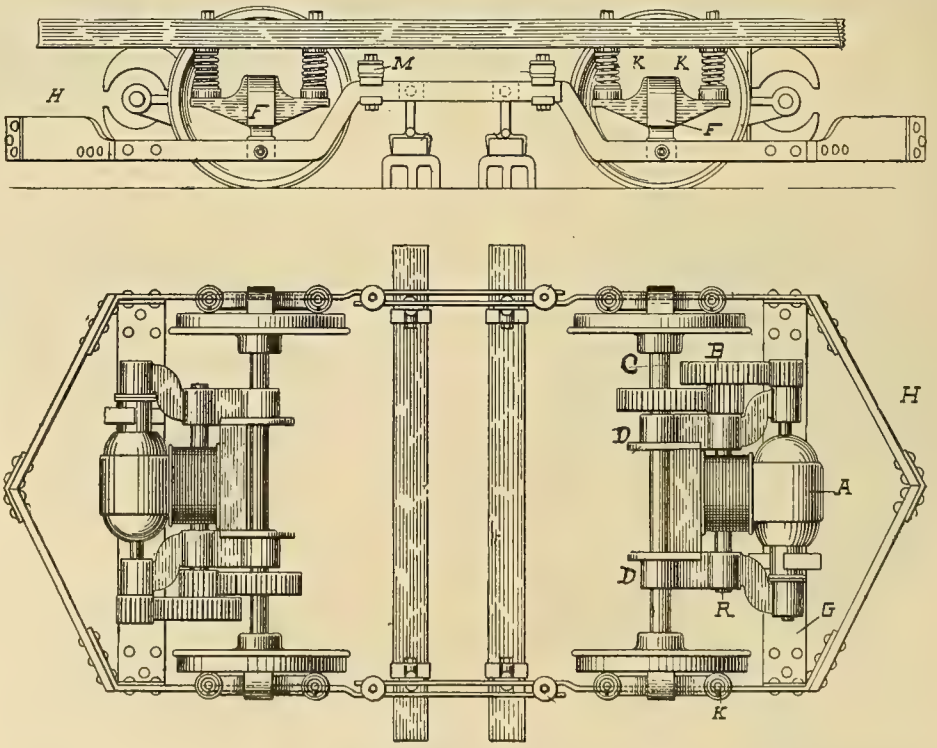
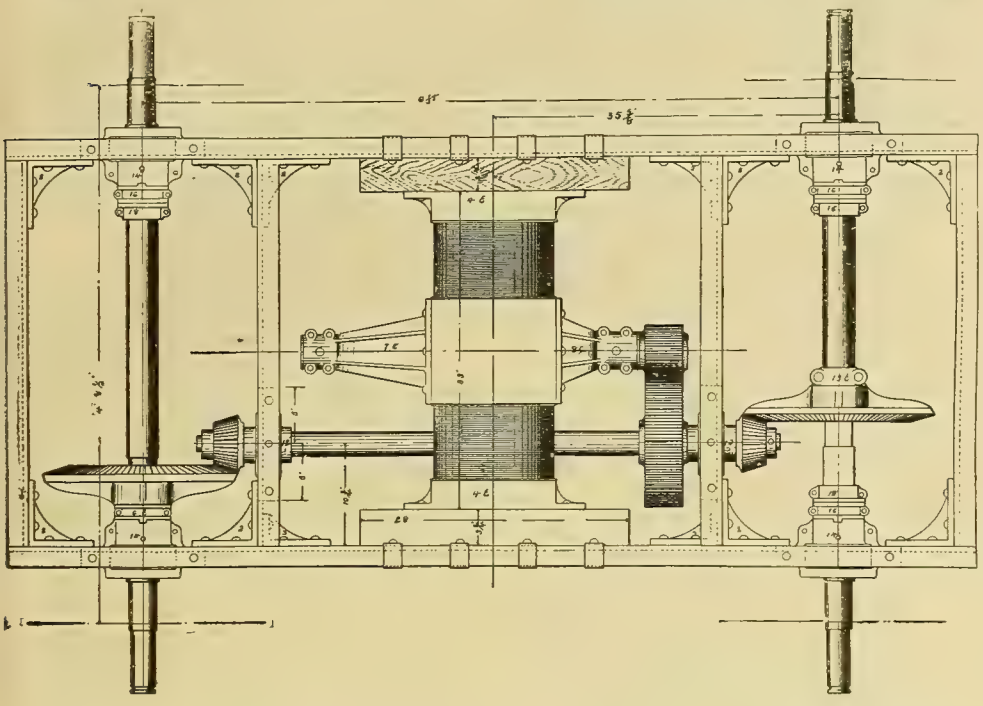


FIG. 1. ELECTRIC MOTOR TRUCK.

Hammerfest, the most northerly town in Europe, is the first town in Norway to be lighted completely by electricity. The Thomson-Houston system is used and motive power is supplied by a waterfall about a mile distant. The installation is satisfactory, and will be extended so as to light the harbor.

Forty Horse Power Rae Motor.

The accompanying illustration shows the new 40-horse power motor that the Detroit Electrical works are building for railway work. A new composition of aluminum bronze is used for the pinions, and it is claimed that this material has three times the tensile strength of steel. The Detroit people have departed from old usages and are selling motors to be used in connection with any of the other systems.



FORTY HORSE POWER RAE MOTOR.

Electricity and Insurance.

At a recent meeting of managers of insurance companies, held in Cleveland, a committee on electric light and power plants and insurance presented an interesting report on the general character of the risks taken by underwriters in insuring electric light and power stations. This is a subject that has caused considerable discussion. Following is an extract:

Rules adopted in foreign countries, as well as at numerous places in this country, have been gathered by your committee, but time for the codification thereof has not been at hand, neither has it been possible to have that conference between the parties interestsd—to-wit, insurance and electric light and power interests—which is necessary before such rules can be thoroughly formulated. The subject, however, is having due attention, and we trust for a satisfactory report at our next meeting.

Your committee begs to submit the foliowing data obtained from reliable sources:

"It is estimated that at the beginning of the year 1890 $600,000,000 was invested in the electrical industry in the United States and that 250,000 persons depended upon it for their living.

"Six years ago there were scarcely a hundred electric motors in operation in the United States for any purpose. To-day there are about 15,000 motors in use, applied to no less than 200 different industries.

"In February. 1885, at the inaugural meeting, the National Electric Light association had but 87 members; now it has over 300, representing almost every portion and all the leading electric light systems of the United States.

"The statistics collected by the National Electric Light association in regard to the use of electric lights show the following:

	1888	1889
Arc lights	209,024	257,0[illegible]7
Incandescents	2,504,1[illegible]	2,704,7[illegible]

"At the close of 1885 there was but one electric road in this country, in the suburbs of Baltimore, two miles in length and a working central rail. Now there are about 250 electric railways in operation, construction or under contract in the United States. These roads comprise nearly 2,500 miles of track. A few are worked by storage batteries; the rest by overhead conductors. These roads are equipped with 3,000 motor cars, requiring four to five thousand motors of an aggregate capacity of over 75,000 horse power.

"With the advantages of the electric railway as clearly demonstrated in actual practice, it will not be unsafe to hazard the opinion that in ten years at farthest there will not be a horse railroad in operation in our country.

"In the year ending June, 1889, there were 834 patents pertaining to electricity. Of these 185 may be classed under the head of telegraph and telephone, while 649 have to do with motors, dynamos, batteries and the general advancement of electric science along the line of light and power.

"The cost of an electric lighting plant is less than one-half of what it was six years ago, and there is every reason to believe that six years from now almost an equal decrease in cost will have been attained

"The rapid introduction of electrical apparatus as soon as its efficiency has been demonstrated is being seen in the remarkable growth of the electric motor industry.

"The electric light station is becoming the great public reservoir of power, and from its circuits all engaged in manufacture, and thousands who need power for various minor services and functions, can draw supplies at will. In a very short time the consumption of current for electric power will equal, if not exceed the consumption for light; and it is to this new idea that electric light men and the general public are adjusting their methods. There is not an electric light station to-day in which provision is not being made, in engines and dynamos, for electric power supply; nor is there a manufacturing industry, within city limits anywhere, in which the use of electric motors is not to be tried or has not already begun."

The committee begs to call the thoughtful attention of members to a possible danger from close proximity of electric wires, gas pipes and water pipes under ground.

It is a well known fact that no receptacle has yet been devised which will hold crude petroleum without evaporation. The volatile nature of this element is such that it will permeate any known substance, and it is now used extensively in the manufacture of gas, the former method of piping, which has not been modernized for gas made of coal, is hardly adequate for the conduct of a gas of which crude petroleum is largely a component part. Water mains can hardly be put down without possibility of leak or breakage. The earth when damp becomes a good conductor for electricity, and when electric light wires, which are intended to carry a current of great power, are laid in close proximity to these pipes the least cross circuit might produce a spark which, coming in contact with earth saturated with escaping gas, might produce an explosion that would be disastrous. Pipes to conduct gas made of coal alone might not be dangerous in close proximity to electric wires, but gas of which crude petroleum forms so essential a part, and the very high pressure used to force the gas through the pipes causing leakage, presents a new danger, the result of which might be appalling.

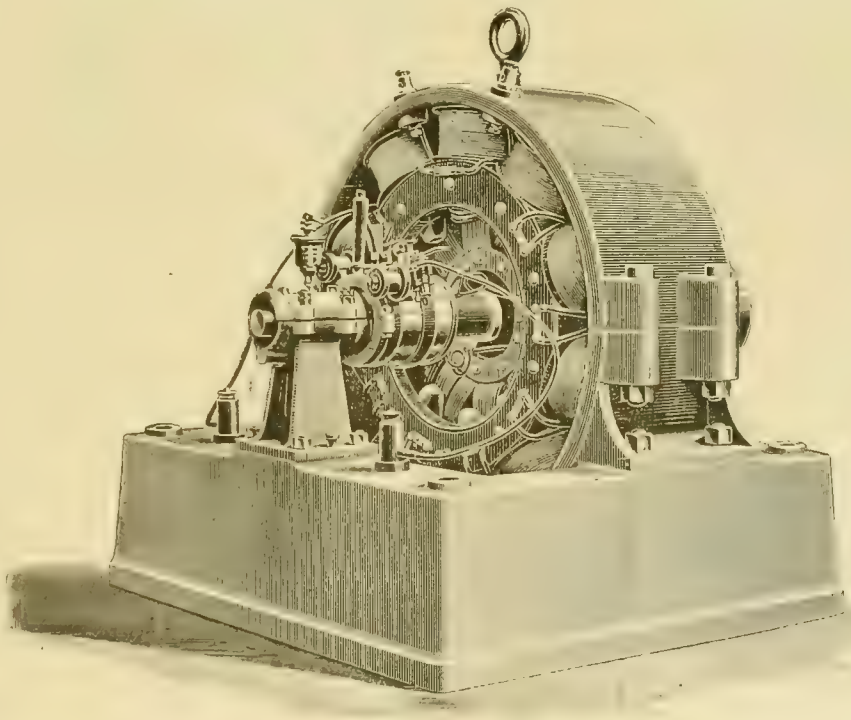
The total number of gas companies in the United States is now about one thousand, of which say 25 per cent. operate electric light plants in conjunction with their business.

In view of the rapid growth and the use of improper forms, it appears to be necessary that uniform policies should be devised, and the committee begs leave to suggest that a committee be appointed to prepare one for adoption.

The committee suggested in the last paragraph of the report was duly appointed. It is to make its report in September.

Tyne Alternating Current Dynamo.

The latest form of the Tyne alternating current dynamo is illustrated in the accompanying cut. There are ten electro magnets in this generator arranged radially around the armature with projecting side cheeks, so that the two sides and the periphery of the armature are exposed to the lines of force. These magnets are joined by a cast-iron ring, which is in halves, forming a support and yoke for the electro magnets; this ring is split through the center and joined together by turned bolts, so that by removing these bolts the top half of the magnet frame can be lifted off and the armature exposed to view. The armature is of the disk type, but the section of iron has been considerably increased above ordinary practice to reduce heating to a minimum. The iron core is made up of a gun metal wheel upon which flat Swedish iron wire is wound between side plates until the required section is obtained; the core is then carefully insulated with mica and 10 coils of wire wound upon it in the case of a 10 pole machine. In machines wound for high tension the two last ends from the armature coils are brought down to two gun-metal collecting rings, which are mounted upon a gun-metal sleeve and insulated from the sleeves by ebonite washers. The magnet frame and bearings, as shown in the illustration, are supported upon a very massive cast iron bed plate. When desired the exciter is connected direct on the alternator spindle, and is placed on an extension of the bed-plate. The cut is reproduced from *Electric Plant*.



TYNE ALTERNATING CURRENT DYNAMOS

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W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. B. O'HARA, - - - - - - - - - - } Associate Editors.
F. L. PERRY, - - - - - - - - - - - }
W. E. KEILY, - - - - - - - - - - }

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

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The WESTERN ELECTRICIAN has received from an authoritative source information that orders have been given by the construction department to complete the plans for the World's Fair buildings according to the present drawings. If this is true, and we have every reason to believe it is, it will be a great disappointment to the electrical interests, as it will mean an electrical display very much inferior to that which the electrical people are expecting and preparing for. It will mean an electrical building only about two-thirds of the required dimensions, notwithstanding the fact that the electrical interests have formally petitioned the World's Fair authorities to make this building at least fifty per cent. larger than it is now planned to be. It will mean the dividing up of the electrical display among several buildings, the greater part of the apparatus going into the electrical building to be sure, but very many of the heavier and more important exhibits going into the machinery, the mines, the transportation and other buildings. Such a dwarfing of the main electrical display by putting elsewhere many of the most important and interesting features will, we believe, be strongly protested against by electricians from every part of the world. J. P. Barrett, chief of the electrical bureau, is at this writing confined to his home by illness and could not be seen by a WESTERN ELECTRICIAN representative. It does not seem possible to us, however, that this action could have been taken with his knowledge and concurrence. Prof. Barrett is a practical electrician and by frequent consultations with those interested, is apparently keeping himself in close touch with the electrical interests with the very laudable idea of meeting the wants of this important industry as far as possible. He knows that the adoption of this plan will meet with the most determined opposition on the part of the electrical industry as a whole. We cannot but think, therefore, that this important step must have been taken without his knowledge. It had occurred to us that it might be the intention to so construct the electrical building as to admit of its extension in case the next two years' developments in the electrical field should demonstrate its inadequate dimensions, but we learn that this building is so crowded in between the artificial lake, the administration building and the mines building that no extension is possible. If the plans for the electrical building are allowed to go on to completion according to the present drawings, it will then probably be too late to make the desired changes and all hope of a satisfactory electrical display must be abandoned. Prompt action is therefore necessary on the part of the chief of the electrical department and on the part of every one interested in making the electrical section the most important feature of the World's Columbian Exposition.

A NOVEL motor installation representing an interesting transformation of energy is illustrated in this issue and will no doubt offer a suggestion to others who are endeavoring to solve similar problems.

THE outlook for the telephone bill in the Illinois legislature is very favorable from the companies' point of view. It is probable that the bill will be buried in the committee room as the members of the senate seem disinclined to impair the service of the Chicago exchange.

IN the classification of the electrical exhibits of the World's Columbian Exposition Chief Electrician Barrett has made the historical department a prominent feature. It will be noticed that he has provided for a display of models of electrical inventions for both this country and foreign nations. This exhibition, it is believed, will be the most elaborate of its kind ever attempted.

A correspondent notes an important victory of the electric system over the cable. The Grand Rapids company has a system of cable railway, the installation of which involved the expenditure of over $2,000,000, and it is now proposed to throw out the entire plant and substitute electricity as a motive power. The change is advocated by a prominent cable expert, who is now in charge of the work.

The interest manifested by street railway managers in every development of the electric system, which tends to diminish the number of parts or otherwise simplify the apparatus, has led to considerable experimenting, both in this country and in England on this line. In a recent issue attention was called to the progress made in the new underground electric railway in London. In this issue we illustrate a new gearless motor for street railway work, which no doubt will be examined with interest by street railway managers, and by all who believe that in the development of the electric railway system will be found the only permanent solution of the problem of rapid transit for large cities.

THE *American Engineer* has a department which it distinguishes from the rest of the paper by the pretentious title "Literary." This is one of the latest bits of information contained in this department: "*Aluminum Age* is the name of a new paper hailing from Newport, Ky. It is a pity they do not know how to spell the name of 'the coming metal'—aluminium." The frisky editor of our esteemed contemporary has evidently just aroused himself from a Rip Van Winkle sleep to learn that "aluminum" is "the coming metal."

IN another column F. W. Horne advocates a system of electric railways for the exposition grounds and explains the method of organization and the government proposed. It appears that the chief opposition to a surface road is the fact that it might be necessary to cross the walks and drives about the grounds. In his article Mr. Horne says that the objection has been made that the overhead trolley wire is unsightly, yet it is proposed to construct an elevated railroad system, which it is claimed would detract much more from the appearance of the grounds. Mr. Horne's proposition is before the World's Fair authorities.

THE formal opening of the telephone service between Paris and London took place March 18. The cable reports say it was a notable event, and was participated in by many prominent officials of England and France. Mme. Roche, wife of M. Roche, minister of industry and the colonies, had the honor of uttering the first words over the new line. M. Roche then held a conversation with Henry Cecil Raikes, the postmaster-general of Great Britain. M. Roche said that he hoped the telephone line would form a fresh link of friendship between Great Britain and France, and many other complimentary speeches were transmitted between the two cities. There is already considerable disappointment expressed in both countries, according to the cable reports over the fact that the regulations and charges will restrict the use of the instruments to a very few persons. It will be of little or no general good under the present arrangements it is feared.

It appears to be the general belief outside of electrical circles that the only feature of the underground system of electric wires that still remains unsolved is the question of cost. This is the position assumed by the Rochester, N. Y., *Herald* in considering the editorial in our last issue. It should be borne in mind that in the underground as well as in the overhead systems the question of safety enters largely into the problem, and until it is satisfactorily solved, the extension of underground work will be more or less slow. The operation of electric wires underground under existing conditions is not unattended with danger, it should be remembered, and these dangers are not generally due to defects in the electric system proper, but rather to the presence of gas in the conduits and the carlessness of workmen. This was clearly shown in the recent manhole explosion in Chicago, which resulted so disastrously. Further evidence on this point is found in the report of the committee of insurance managers on this subject, which is presented in another column. This report reviews the dangers to which the present condition of affairs expose the public. The remedy for the trouble rests with the gas companies. Improved construction work in their street mains alone will remove the danger.

In view of these facts it is not surprising that the electric companies hesitate when they are asked to invest immense sums of money in underground construction, which may be instantly destroyed by a careless plumber or gasfitter.

Electric Timing Apparatus for Photographers.

As the use of photography in engraving extends, the necessity for using some automatic device for regulating the exposure of sensitive films becomes more generally appreciated. The cause of many failures in photo-engraving is to be found in the fact that exposures are not properly timed. In the accompanying cuts are shown two electrical devices, invented by W. A. Blomgren of Chicago, for sounding an alarm and shutting off light from a camera when a given period, during which a sensitive

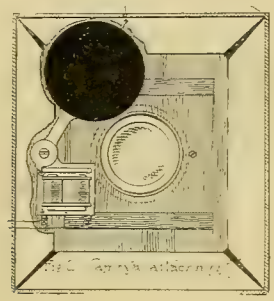

FIG. 2. ELECTRIC TIMING APPARATUS FOR PHOTOGRAPHERS.

film is to be exposed, has expired. The timing and alarm device is shown in Fig. 1. The dial is so arranged that provision is made for exposures of from fifteen seconds to sixty minutes, according to the necessities of the case. Suppose for example it is desired to make a five-minute exposure. The small indicator nearest the dial is set at the five-minute mark; the lever, shown at the right, is lowered, which causes the clock work to clutch the large hand on the dial, and set it in motion. At the end of five minutes the large hand comes in contact with the small pointer, and the electric circuit is closed. The gong shown at the top of the instrument rings, which announces to the operator the fact the that time of exposure has expired.

When the circuit is completed the light is shut off from the camera by the device shown in Fig. 2. The device is placed just back of the lense. When the circuit is completed the armature of the electromagnet shown in the cut, is attracted, and the shutter falls, thus cutting off the light and preventing further exposure.

After the large hand has made contact with the pointer it rubs by the latter and breaks the contact. By raising the lever at the side the clutch is released, and the large hand flies back to its original position.

The clockwork in the instrument is an eight day movement. Current is provided by a battery of two dry cells, which are fastened in the lower part of the box, Fig. 1. The device has been used with success by Mr. Blomgren in his photo-engraving establishment, in Chicago.

Sperry Specialties.

The Sperry Electrical Mining Machine company of Chicago has recently added tools and

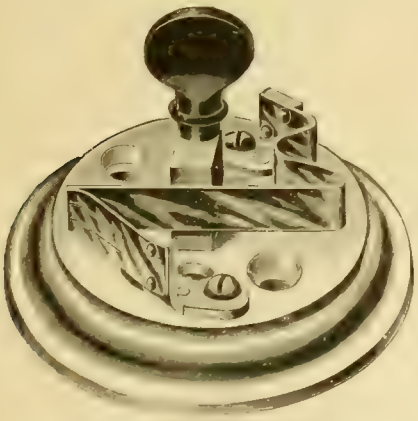

FIG. 1. SPERRY SPECIALTIES.

equipment for manufacturing on an extensive scale the "Sperry Supplies and Specialties." The accompanying cuts show three devices.

Figs. 1 and 2 represent the Sperry single and double pole incandescent snap switches.

Fig. 3 represents a detachable rosette cut-out. As illustrated the bases are provided with holes for receiving the wires at the back, also with grooves to admit wiring for cleat work of any width. The appearance of this cut-out is unique. The design is neat, the grooves giving it an ornamental finish, at the same time furnishing perfect ventilation, which prevents staining of coilings in case of blowing the fuse. The outside connection rosette resembles the "Universal" with the exception that the terminals are brought outside the base. Both rosettes and switches are manufactured in wood and porcelain.

Transportation at the World's Fair.

By F. W. Horne.

In reply to the editorial in your issue of the 14th instant as to what steps have been taken by any of the electric companies for the purpose of exhibiting motor cars at the World's Columbian Exposition in 1893, I beg leave to submit the following:

On June 10, 1890, I submitted the following proposition to the World's Columbian Exposition:

Lyman J. Gage, President World's Columbian Exposition:

Dear Sir: Agreeable to our conversation of yesterday regarding electric railways, I beg leave to submit the following for consideration at the proper time. If granted the right, myself and associates propose to build a standard electric railway within the exposition grounds to and from such points as may be desired. The motive power to be employed will be that of electricity in its various forms; keeping the railway open at all proper times for the va

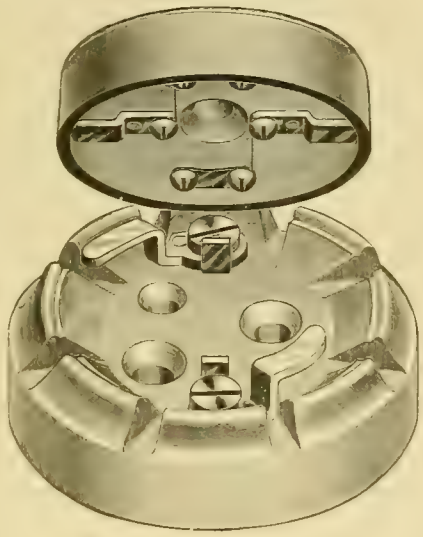

FIG. 3. SPERRY SPECIALTIES.

rious electric motive manufacturing companies of the world to exhibit practically the workings of their systems; the railway to be provided with the necessary safeguards, such as fences, gates and viaducts at the entrance to the grounds; the stations to be located at the various points desired, where only access to the railway can be had through turnstiles for the registration of all passengers. The railway herein proposed, with the necessary motive power, palace cars, generators and steam plant, to be furnished by myself and associates without expense to the exposition, except that the exposition company is to furnish and deliver to our engines the necessary steam for operating said plant.

The exposition company is to be compensated for the above grant by a certain percentage of the gross receipts that may be agreed upon hereafter. The amount of gross receipts to be determined by the registering turnstiles daily.

My apology for having brought this before you at this early date is that in laying out the grounds it might be advisable to consider the means of transportation within the grounds to the various points of interest. In that event I ask this to be filed as my formal application for this grant, being ready at any time to furnish bonds for the fulfillment and performance of the grant, and ready at all times to appear before yourself or such committee as you may appoint for the investigation of this railway scheme in detail and the responsibility of the parties asking the grant.

The above proposition was considered at the time of its receipt by the board of directors of the exposition, and was referred by President Gage to the mechanical and electrical committee. A copy of the same was also forwarded to the buildings and grounds committee, to the ways and means committee and the director-general when he was duly appointed, and a copy was also forwarded to each of the standard electric companies in the United States, or its representatives, stating that it was proposed that if I received this grant, in all probability there would be use for five motors from each company; that the motors required should be at least 30-horse power per car, and should be capable of making an average schedule time of

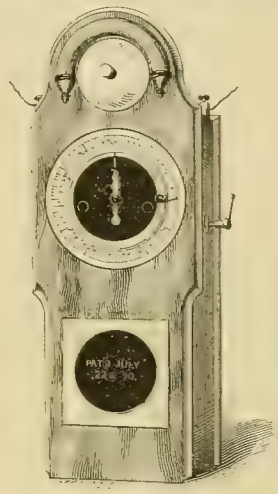

FIG. 1. ELECTRIC TIMING APPARATUS FOR PHOTOGRAPHERS.

12 miles per hour; that the motor car should be operated under rules and regulations to be approved by the director-general of the World's fair, or such other person as he might designate to look after the interests of the exhibitors on this railway. The generating power is to be divided up equally among the various standard companies which have generators suitable for operating motor cars; and in order to operate these generators for one system of railway separately it will be necessary to break the trolley wire up into sections a mile or more in length and feed direct from the power station to each mile of the trolley wire by means of an underground conductor if the exposition company adopt a surface railway. This method would give each generator its share of the motor work and permit the various motor cars to be operated from the different generators according to the section of track passed over. The various electric companies furnishing apparatus are to have the right to provide motor men and conductors, with the privilege of sounding the praises of their particular system, but the conductors and motor men must comply with all rules and regulations made by the director-general or such officer as he may designate, and to be paid by the railroad company at wages equal to those of any other railway company in the United States; there being no objection, of course, to the various electric companies paying higher prices to the men if they should so desire. It is also understood that each electric company will furnish one mechanic to look after its motors, his services, however, to be paid for by the railway company.

Up to the present time four of the leading

FIG. 2. SPERRY SPECIALTIES.

companies in the United States have signified their willingness to join such an enterprise, and each has named its representative, who is to be

a director in the railway company, if the grant is secured. The fifth company has the matter under consideration, and has informed me that in all probability it will be associated with the undertaking.

The objection to the above scheme when first proposed to the electric companies was that the person making the request for the grant was in the employment of one particular company. This objection has been overcome by requesting each company to have a representative on the directory to have equal powers with myself. The application would have to be made by some one, and, whoever that person might be, he certainly would at one time or another have been connected with some electric company; and it seemed to the writer that it was much better for a practical railway man to secure this grant than an outsider who had no knowledge whatever of electric motor traction or street railway operation. This same view was entertained by prominent directors of the exposition company. President Gage was of the opinion that outside parties should furnish the capital and operate the railway, giving to the exposition company a certain percentage of the gross receipts, thereby permitting the exposition company to use its capital for buildings and other necessities, which it could not well have outside parties interested in. Moreover, the exposition company did not care to take the responsibility of becoming a common carrier and thus liable for damages, etc., as is likely to be the case in the operation of a railway system.

Up to the present time the directors of the World's Columbian exposition have not gone on record as to whether they prefer an elevated or surface railroad, nor has the board of architects, although it is generally understood that the latter favors an elevated railroad, for the reason that it gives easy access to and from all points in the ground without hindrance. At the same time the architects realize the unsightliness of an elevated railroad and therefore do not propose to permit the erection of one in front of any of the main buildings, or, in fact, anywhere near them. They would relegate it to the rear of the buildings, but unfortunately the majority of the buildings have no rear to them, having the artificial lake on one side and Lake Michigan on the other. It is therefore intimated that they will only permit the railway to be operated in the minor or unimportant parts of the exposition grounds, thereby giving little, if any, convenience to the traveling public.

The consulting engineer is said to have advocated the use of a single track elevated road, run in the form of a loop, and to have the cars on this loop operated continuously without any rest whatever, except stopping at the railway stations to allow passengers to get off and on, keeping the motors in continual operation in the form of a merry-go-round. This proposed system is to straddle the road bed with the railway cars for the purpose of preventing the car from getting off the track. It is to be equipped with special motors, which are yet to be designed. The Chicago daily papers have explained the system fully, showing that the inventor proposes to make an average schedule time of 25 miles per hour on a headway of 20 seconds, which gives the astonishing result that he is going to operate motors about 704 feet apart at a speed of 25 miles per hour. It is to be hoped that he will provide a flexible method between each and every train to prevent a series of concussions. There is, however, little fear that any particular system will be operated within the fair grounds to the exclusion of any other. All schemes of every nature have to come first before the buildings and grounds committee, which is made up of able, conservative business men, who will be very slow to adopt any theoretical scheme. Should the buildings and grounds committee report favorably upon the scheme, it then would go to the mechanical and electrical committee for consideration as to its feasibility; thence to the electrical bureau, which has lately been organized; thence to the ways and means committee for terms and conditions governing the proposed grant; thence to the director-general for his consideration and approval, and finally to the full board of directors for confirmation or rejection.

The only fear there is in this railway matter at the World's Columbian exposition is, as stated in your editorial, that action may be deferred until such time as the architects have located their buildings so that it will be impossible to furnish adequate intermural transportation. Undoubtedly the architects will locate their buildings in such manner as to have the finest and most pleasing effect. They will object to any railway passing in front or at the side of these buildings for fear of marring the view, and it is a question for the directors to consider carefully whether it is best to sacrifice a little beauty for great utility.

To the members of the buildings and grounds committee I have claimed that in an electrical railway constructed with the ties eight inches below the ground, with rails set on chairs, the entire road-bed could be covered with a rich soil, and grass and flowers be sown from one end of the line to the other; that the poles should be of iron, set between the double track, with neat and ornamental brackets for the suspension of the trolley wire, and vines could be trained on the poles, if desired, as an ornament to the grounds; that the railway be inclosed from one end to the other with a neat ornamental fence of an open design, which would not obstruct the view a particle, or detract from the appearance of the buildings; that viaducts be located at each railway station, and a fence be put between the double railway tracks at the stations to prevent passengers crossing the tracks, having access to the other side of the railway tracks by means only of the viaduct. It may also be necessary in places for the railway to pass over the viaducts, and in this event it would be easily accomplished on an 8 per cent. grade.

The engineers of the exposition do not seem to realize that an electric railway can be operated satisfactorily on anything over a grade of 52 feet to the mile, as in steam railway work; but even if the board of directors of the World's Fair should decide on an elevated railroad the structure certainly should be double track and be of standard gauge suitable for the various electric motor companies of the United States to exhibit their cars practically thereon, and not so constructed as to be suitable for only one particular system which is not in existence on any railway in the United States at the present time.

There is no question but that electric power will be the cleanest and most desirable method of operating the elevated railroad as well as a surface road, but the great objection to an elevated railroad is the cost. With a generous imagination as to the number of passengers carried the total gross receipts would not equal one-half of the first cost. In the city of Chicago an elevated railroad is objected to by every property owner in front of whose building it passes; and on the South side one was not even permitted to be operated on State street, but was placed back in the alley, in the rear of stables and coal sheds. Yet this same objectionable form of railroad is being advocated for the magnificent grounds of the World's Fair!

One engineer of the World's Fair even raised the objection against a surface railroad on account of the single trolley wire, and in the same breath advocated this unsightly elevated railroad, which is equal in unsightliness to a thousand of such trolley wires. Again, it is not necessary to have access to and from all points of the exposition grounds, because, as a matter of course, people will not be allowed to run wild, and cross the grounds at pleasure, but will be confined to the various walks; therefore it is only the cross walks where they would have to have viaducts or the railway pass by means of viaducts or by subways.

Electrically Operated Pianos at the World's Fair.

Dr. G. P. Hackenberg of Austin, Tex., is negotiating with the directors for the introduction of his "musical telegraph system." He proposes to utilize ten pianos, each provided with electrical attachments and all connected with a keyboard, which shall be under the direction of an operator or musical director. This keyboard should have ten keys, he says; one for each instrument. By manipulating these keys the director would make and break the electrical connections between the instruments. The pianist occupies one of the pianos. He has no new duties to perform in playing the combination, as the expression is mainly rendered by the musical director. The object of having pianos is not so much to secure a uniform loud volume in music by the simultaneous action of the instruments, but to give rapid runs without taking two successive notes from the same instrument and otherwise render artistic expression, reaching the ear from different points, and affording a timbre of its own with the widest range of harmony.

The whole affair could be put in operation for a few thousand dollars and would make a very attractive musical feature, besides showing a new use for electricity.

Electrical Section of the World's Fair.

Chief Electrician Barrett and Secretary Hornsby have issued a new classification of the electrical department of the world's fair. It comprises eighteen groups and sixty-three classes, arranged in the following order:

GROUP 119.

Apparatus to illustrate the phenomena and laws of electricity and magnetism.

Class 718. Statical electricity.
Class 719. Thermo electricity, thermo-electric batteries.
Class 720. Magnets, temporary and permanent.
Class 721. Induction coils, converters, etc.

GROUP 120.

Apparatus for electrical measurements.

Class 722. Standard resistance coils.
Class 723. Standard condensers.
Class 724. Standard batteries.
Class 725. Instruments of precision, voltmeters, ammeters, wattmeters, etc.

GROUP 121.

Electric batteries, primary and secondary.

GROUP 122.

Machines and appliances for producing electrical currents by mechanical power—dynamical electricity.

Class 726. Dynamos of direct constant e. m. f., varying current.
Class 727. Dynamos of direct constant current and varying e. m. f
Class 728. Dynamos of alternating current, constant e. m. f. and varying current.
Class 729. Dynamos of alternating constant current and varying e. m. f.

GROUP 123.

Commercial transmission and regulation of the electric current.

Class 730. Cables, wires and insulation, rheostats, switches, indicators, registering meters, ammeters, voltmeters.
Class 731. Safety and protective appliances, lightning rods, lightning arresters, insulators, fusible cut-outs, safety switches, etc.
Class 732. Conduits, interior and underground.

GROUP 124.

Electric motors.

Class 733. Direct constant current.
Class 734. Direct constant e. m. f.
Class 735. Alternating current.

GROUP 124 *A*.

Application of electric motors.

Class 736. Street, underground, mining and other railways.
Class 737. Elevators, pumps, printing presses and general machinery.
Class 738. Toys, novelties and domestic appliances.

GROUP 125.

Lighting by electricity.

Class 739. The arc systems, their lamps, fixtures and appliances.
Class 740. The incandescent systems, their lamps, fixtures and appliances.

GROUP 125 *A*.

Heating by electricity.

Class 741. For warming and heating apartments.
Class 742. For heating flat-irons, soldering irons and other objects used in industrial operations.
Class 743. Maintenance of constant high temperature in ovens.
Class 744. Electric furnaces.

GROUP 126.

Electro metallurgy and electro chemistry.

Class 745. Electrotyping.
Class 746. Electro plating, gilding and nickeling.
Class 747. Electro deposition of iron and other metals.
Class 748. Electrolytic separation of metals from their ores or alloys.

GROUP 127.

Electric welding, stamping, tempering, brazing, etc.

Class 749 *a*. Apparatus for, and methods of welding or joining iron, steel and other metals.
Class 749 *b*. Brazing, stamping, tempering, etc.

GROUP 128.

Electric telegraph and electric signals.

Class 750. Various systems of transmitting and receiving.
Class 751. Chronographs.
Class 752. Annunciators.
Class 753. Thermostats.
Class 754. Fire alarm apparatus
Class 755. Police telegraph and burglar alarm apparatus.
Class 756. Railroad signal apparatus.

FIG. 1.

GROUP 129.

The telephone and its appliances.

Class 757 *a*. Cables, construction and underground work.
Class 757 *b*. Special protective devices.
Class 757 *c*. Switch-boards.
Class 757 *d*. Transmitting apparatus.
Class 757 *e*. Receiving apparatus.
Class 757 *f*. Signaling apparatus.
Class 757 *g*. Long distance systems.
Class 757 *h*. Various systems of operation.
Class 757 *i*. Subscriber's apparatus: numbers, code, registers, etc.

GROUP 130.

The phonograph.

Class 758. Receiving and recording apparatus.
Class 759 Apparatus for the reproduction of recorded sounds and articulate speech.

GROUP 131.

Electricity in surgery and therapeutics.

Class 760. Cautery apparatus.
Class 761. Apparatus for the application of the electrical current as a remedial agent.
Class 762. Apparatus for diagnosis.
Class 763. Apparatus for the destruction of life.

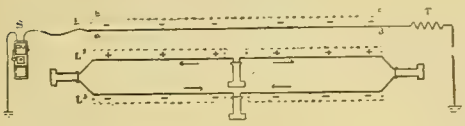

FIG. 2.

GROUP 132.

Applications of electricity in various ways not before specified.

Class 764. Ignition of explosives, gas lighting, etc.
Class 765. Control of heating apparatus by electricity, as applied to steam and hot air pipes and registers.
Class 766. Electric pens.
Class 767. Application in photography.

GROUP 133.

History and statistics of electrical invention.

Class 768 *a*. Objects illustrating the development of the knowledge of electricity and of the application of electricity in the arts.
Class 768 *b*. Collections of books and publications upon electricity and its applications.

GROUP 134.

Progress and development in electrical science and construction, as illustrated by patent models of various countries.

Class 769 *a*. United States patent office exhibit of electrical models.
Class 769 *b*. Foreign patent office exhibits of electrical models.

FIG. 3.

This classification is more comprehensive than the old one. Among other additions is the group of exhibits founded on Prof. Barrett's idea of showing the growth of the application of electrical science by the patent office records.

The manner of exhibiting electric railway systems on the exposition ground is now under discussion in the electrical and construction departments. If possible, one line of track of standard width will be so laid out that all of the various overhead, conduit and storage battery systems can be shown upon it. This miniature railroad will probably be distinct from the intermural transportation line, and it is thought will be adjacent to the electrical building.

Inductive Disturbances in Telephone Circuits.[1]

BY J. J. CARTY.

It was not known until 1838 that the earth might be used instead of a return wire in the circuit of a telegraph line. This fact was discovered by Steinheil, while making experiments to determine whether the track of a railroad could be used to complete the circuit instead of a return wire. Steinheil's discovery has been considered as one of the most important in the art of telegraphy, and since his time it has been the almost universal practice to use the earth as a return in telegraph circuits. When, however, the earth return is used with the telephone, it is found that, owing to the extreme sensitiveness of that instrument, many foreign currents, which would produce but little effect on telegraph instruments, become a source of serious trouble. For this reason in telephony it is often necessary to use a complete metallic circuit. Thus it has come to pass that a return to the original practice of employing metallic circuits, as in the case of the crudest telegraph instruments, is now regarded as a most important improvement in connection with that most highly developed of telegraph instruments, the telephone.

To obtain complete freedom from inductive disturbances in the telephone it is necessary, not only to use a metallic circuit, but to place the two wires composing the circuit in a special relation to the source of disturbance. One of the methods of so arranging the wires is shown in Fig. 1.

In this case the two sides of the circuit L^2 and L^3 are twisted spirally about each other, so that their average distance from the disturbing wire L^1 shall be the same. With

FIG. 4.

such a plan, the telephones *a* and *b* are not affected by induction from the wire L^1. This fact has usually been explained by assuming that a current, commencing to flow in L^1, tends to induce two currents in the opposite direction to itself, one in the wire L^2 and the other in the wire L^3; that both currents are of the same strength because the average distance of L^2 and L^3 from the disturbing wire L^1 is the same; and that the telephones *a* and *b* are silent because they are acted upon by two equal and opposite forces. The above theory seems at first sight to be correct, and indicates the line of explanation adopted in many works treating of the subject.[2]

I have made a number of experiments which seem to prove that in the case described the inductive action, instead of tending to produce a simple current in each side of the metallic circuit, actually does produce a number of different currents in each wire and in both directions.

In Fig. 2, L^2 and L^3 are two well insulated copper wires, 500 feet long and three feet apart. These wires are joined together at each end through an ordinary telephone. L^1 is a well insulated wire similar to the other two and placed within one-half an inch of L^2. At one end of L^1 is placed a Blake transmitter *T* and at the other end is placed a subscriber's bell *S*, L^1 being grounded at both ends as shown. When the transmitter *T* is operated, either by speaking into it or by vibrating a powerful tuning fork in front of it, disturbances are produced at the end telephones.

If telephones are inserted at the center of L^2 and L^3 it is found that at those points no sound is heard, while the noise of the end telephones continues as before. This constitutes a simple case of inductive disturbance, and can

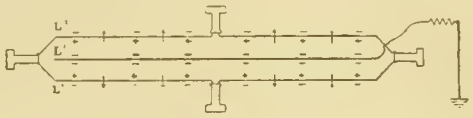

FIG. 5.

only be explained by assuming that the wire L^1 acts electrostatically upon the circuit composed of L^2 and L^3, or, in other words, that we are dealing with a system of condensers in series, of which L^1 constitutes one plate, the earth another and the wires L^2 and L^3 two intermediate plates which are joined together through the end telephones.

Let us assume that at a given instant the height of potential along the wire L^1 is represented by the lines *a b* and *c d*, and the charge upon L^1 by the rectangle *a b c d*. The presence of this charge, which we will say is of the minus sign, is accompanied by an equal but plus charge on L^2. This produces a minus charge on the wire L^3, which in turn acts upon the earth. Now we will assume that the potential on L^1 is reduced to zero. This causes a restoration of the equilibrium in the circuit composed of L^2 and L^3, which is accompanied by a set of currents as represented by the arrows. The plus charge on L^2, flowing through the end telephones, neutralizes the minus charge on L^3, thus leaving a neutral point at the center of each of the wires L^2 and L^3.

In this and the succeeding experiments the induced charges are represented by rectangles. This is not a strictly accurate method, but as an error in this respect only affects the result quantitatively, and cannot alter the conclusions, I have adopted it on account of the simplicity of treatment which it permits.

The potential along the wire L^1 at a given instant is represented as being constant, as it is found that owing to the high impedance in the instrument *S*, there is practically no fall of potential in the wire itself. Furthermore, it was found in the experiments about to be described that the results were the same whether the disturbing wire was open or connected to earth through the bell *S*. There would be a fall of potential along the wire L^1 if it were of such a length as often found in practice, and the distribution of the charge would be modified accordingly. But as this fact would only affect the location of the neutral points, the question of the fall of potential will not be taken into consideration, and the disturbing wire will be shown open at one end.

Fig. 3 shows the same circuits as used in the previous experiment, except that the wires L^2 and L^3 are caused to change places at their centers, but are continued in the same plane, as in Fig. 2. This is what is called a "trans-

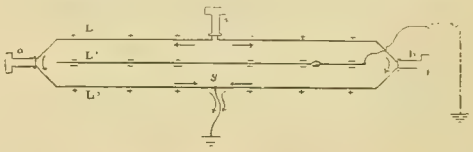

FIG. 6.

position." The telephones at the ends and in the middle are retained as before. Under these conditions, when the transmitter is operated, a diminished sound is heard at *a* and *b*; and *x* and *y*, instead of being silent, as in the first case, now emit a sound of the same intensity as *a* and *b*. When telephones are placed at the quarters *l*, *m*, *n*, *o*, the sounds at *a b* and *x y* continue as before, but nothing is heard at *l*, *m*, *n*, *o*. The effect of this one transposition has been to reduce the disturbance at the end telephones *a* and *b*, and to cause a shifting of the neutral points from the centers to the quarters, and an increase of their number from two to four.

An examination of the induced charge shows how these results have been brought about. It will be seen by reference to Fig. 3 that there is on the first half of L^2 a positive charge, and on the second half a negative charge, and on the first half of L^3 a negative charge and on the second half, a positive charge. When the positive charge on L^2 discharges, half of it goes through the telephone *a*, and half through the telephone *y*. The positive charge on L^3 escapes in a similar manner, half going through telephone *x*, and half through telephone *b*. This produces four currents, two starting from point *l* and two starting from the point *n*. One of the currents from *l* meets a current at *o*, coming from the point *n*, and one of the currents starting at the point *n* meets a current at *m*, which started from *l*. The currents flowing through the end telephones in this

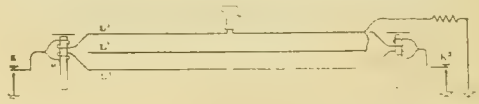

FIG. 7.

case are not so strong as when no transposition is employed, because they are due to an induced charge which is represented by an area half as great. It is found that as the number of transpositions is increased the number of neutral points is also increased, and that the area representing the charge, which escapes through the end telephones, is reduced. To obtain silence, therefore, it is necessary to increase the frequency of transpositions until the discharge through the end telephones is so small as not to produce sounds therein. Fig. 4 shows a circuit containing three transpositions, one at the center and one half way between the center and each end. In this case, if we could neglect the resistance of the telephones, the current going through the ends would be reduced to one-fourth of its original proportions, and eight neutral points would be produced, one in each wire at the center of each transposition.

In practice the impedance of the telephones must be taken into consideration, so that if in Fig. 3 the middle telephones *x* and *y* were omitted, the neutral points would be found to move toward the ends, and the currents flowing through the end telephones would be correspondingly reduced.

According to this theory of transpositions, if the instruments and distances between wires on a given circuit remain constant for a given period of alternations in the disturbing wire, the number of transpositions necessary to obtain silence will depend on the e. m. f. of the disturbing wire, and the specific inductive capacity of the dielec-

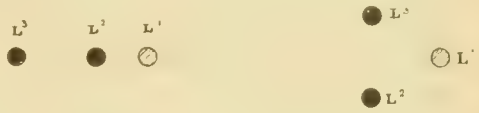

FIG 8.

tric. An increase in the value of either of these factors will, if silence is to be maintained, require additional transpositions, their number depending upon the value of the change which is made.

Where the disturbing wire is placed at an equal distance from both sides of a metallic circuit, no noise is produced in telephones located in that circuit, and a balance once being obtained, it is independent of both the e. m. f. of the disturbing wire and the specific inductive capacity of the dielectric. Fig. 5 shows such an arrangement of circuits. L^2 and L^3 are the two wires composing the metallic circuit placed the same distance apart as before, and the disturbing wire is at an equal distance from both. When the disturbing wire is in operation, no sound is heard at the end telephones, or at telephones located at the centers. This may be accounted for by assuming that at a given instant a negative charge is on the disturbing wire, which produces a positive charge on the inside of L^2 and L^3 and a negative charge on the outside of those wires; and that

[1] Read before the American Institute of Electrical Engineers, May 27, 1890.

[2] "A Handbook of Telephony," by Prof. Gordon, p. [illegible]; "The Telephone," Prof. A. Macfarlane, [illegible] page [illegible]; "Die Technik des Fernsprechwesens," Dr. A. Wietlisbach, 1887, p. [illegible].

when the charge is removed from the disturbing wire, a set of currents is set up in the wires L^2 and L^3 in a direction at right angles to their axes, as shown by the arrows. In this case the flow is lateral, and no current passes through the end telephones or through telephones located at the centers. It will thus be seen that this method of arranging wires differs essentially in its action from the plan of using transpositions Unfortunately, however, its practical application is limited to two circuits.

When the disturbing wire occupies the position shown in Fig. 5, the flow in the conductors is lateral only when the wires L^2 and L^3 are insulated from the earth. If a ground be attached to the center of L^3, as shown in Fig. 6, the flow of currents becomes longitudinal, and the telephones *a* and *b* are found to be affected by loud disturbances, while the telephone *x*, at the center of L^2, is found to be silent. This is because the disturbing wire, which we will say is negatively charged, induces a positive charge upon L^2 and L^3 and a negative charge upon the earth. The discharge in this case is effected by two currents starting from *x*, which thus becomes a neutral point, and passing through the end telephones to the ground as shown by the arrows. If the ground be removed from the point *y* toward the telephone *a*, the neutral point will be found to move toward telephone *b*, and if the ground be put at the center of resistance of the telephone *a*, the neutral point will be found to be at the center of the telephone *b*. This is well illustrated in Fig. 7, where *a* and *b* are telephones of special construction, admitting of the attachment of grounding keys K^1 and K^2 at their respective centers. In this instance, when the disturbing wire is in operation and both keys open, no sound is heard at any of the telephones, the flow of current being lateral. If the key K^1 be closed, sound is immediately heard at telephones *x* and *y*, located at the centers of L^2 and L^3, but the telephones *a* and *b* are still silent. This is because the charge and discharge take place along the conductors L^2 and L^3 to and from the earth at K^1, thus passing through *x* and *y*, *a* being silent because the currents go through it differentially, and *b* is silent because it is located at a neutral point. To prove that current flows through telephone *a*, another telephone may be inserted in the ground branch at K^1, and it will be found to be loudly affected. If both keys K^1 and K^2 are closed, silence is again obtained in the four telephones *a*, *b*, *x*, *y*. In this case the charge and discharge from the wires L^2 and L^3 divide at the center and flow back and forth at both ends, *x* and *y* being silent because they are at neutral points, and *a* and *b* are not affected by the currents, which flow through them because of the differential action referred to.

Two systems have now been described, one in which the induced current is lateral, and the other in which it is longitudinal. I think it follows from the foregoing experiments that where wires are twisted about each other as

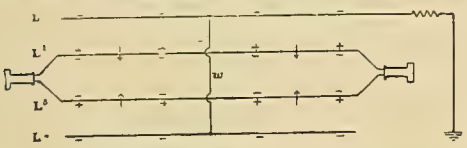

FIG. 9.

shown in Fig. 1, both of these actions are combined. At the left hand of Fig. 8, a cross-section of the three wires, L^1, L^2 and L^3 [Fig. 1] is shown. In this position the wires occupy a place with reference to each other exactly as in Fig. 2, and the tendency of the disturbing wire is to cause a longitudinal flow in L^2 and L^3. If repeated cross-sections of these wires are made, a point will be reached at which the three wires are disposed as shown at the right hand of Fig. 8, where it is seen that the disturbing wire L^1 is at an equal distance from L^2 and L^3, and the tendency is to produce a lateral flow. The actual currents produced must be the resultant of these two actions.

Fig. 9 shows a plan quite different in principle from anything heretofore employed. It is of interest not so much on account of any practical application which it may have at present, but because it is a very striking proof of the electrostatic nature of inductive cross talk between telephone circuits L^1, L^2 and L^3 are the same wires as used in the previous cases, L^1 being half an inch from L^2, with the addition of an extra wire L^4 placed half an inch from L^3 and joined by a conductor *w* with the disturbing wire L^1. L^2 and L^3 are three feet apart. When in this condition the transmitter is operated, no disturbance whatever is heard in the end telephones; if the wire *w* be disconnected, the usual noise is heard, but is found to disappear as often as L^1 and L^4 are joined together. This action is explained by the fact that L^4 is at the same potential as L^1, on account of being joined to it by the wire *w*, and acts with the same force on L^3 that L^1 does on L^2. The flow in this case is lateral, as indicatad by the arrows; and the telephones are silent.

Neutral points may be produced in a circuit by the use of shunts. Fig. 10 shows the usual arrangement of circuits with the telephones *a* and *b* at the ends, and another telephone *x*, of equal impedance branched between the two wires at the center. In this case four neutral points are found, two in each wire. The currents produced by the discharge are indicated by the arrows. Thus by the addition of one shunt the disturbing currents in the end telephones have been reduced one-half. If similar shunts were placed at the quarters, the currents at the end telephones would be still further reduced to one quarter of their original strength.

The plan is not a practicable one because of its shunting effect on the telephone current, but is of value as showing one of the actions which occur when instruments are bridged into metallic circuits. It is interesting to note that in Fig. 10 the telephone *x* is affected by a current twice as great as that which flows through either of the end telephones.

Before closing I shall describe one more experiment: In Fig. 11, L^1 is the disturbing wire and L^2 is a grounded telephone circuit placed one-half an inch from L^1. At the center of L^2 there is an ordinary telephone repeating coil or transformer *C*, containing two windings *e* and *f* of copper wire, each having a resistance of 160 ohms. One end of each winding is grounded, and the other end is connected to the line as shown. Assuming that the impedance of each telephone is equal to that of each coil of the transformer, a neutral point will be found at the center of each half of L^2, and the disturbing currents flowing through the end telephones will be only half as strong as though the transformer were omitted. If now the connections of the transformer be reversed, so that the discharges from the two sections of line pass through it in opposite directions, no magnetism will be produced in the core *k*, and consequently the transformer coils offer an easier path to the discharge. This causes the neutral points to move toward the end telephones and consequently reduces the disturbance still further.

I have not had an opportunity of trying this experiment with a transformer whose coils contained a low copper resistance and a high inductance, but according to theory

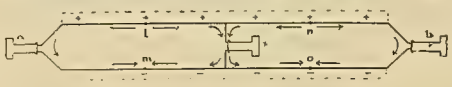

FIG. 10.

we might expect that such a transformer, having its coils connected differentially, should free a grounded line of considerable length from cross talk and other electrostatic disturbances. The number of such coils which can be worked in a given line is of course limited, but with properly designed apparatus a large number of them might be used. This arrangement is also interesting when considered with reference to electro-magnetic induction, and brings to mind a question as to whether we may not at some future time abandon the use of metallic circuits and again make use of Steinheil's discovery.

SUPPLEMENTARY NOTE, COMMUNICATED TO THE SECRETARY BY THOMAS D. LOCKWOOD.

I understand that Mr. Carty's paper is to be read this month. If in that understanding I am correct, I regret exceedingly that it is not in my power to be present with you in a tangible form. It is moreover difficult to make a written communication upon a topic which as yet is unannounced, but as I have some reason to believe that Mr. Carty will speak upon the subject which he has largely made his own I will have the temerity to hazard a word or two.

If Mr. Carty continues to hold the views of two years back, I understand him to believe that electrostatic in contradistinction to electromagnetic induction is chargeable with the major amount of discredit as an agency in disturbances on telephone lines; or, at any rate, that is a much more important agent in the development of such disturbance, whether noise or cross talk, than has been supposed.

From long experience and observation it appears to me that the several agencies in causing disturbing phenomena in telephone circuits, which manifest themselves in the telephone receiver, preponderate largely in accordance with the conditions of the circuit; that the environment (to use the language of social science) of a telephone circuit has a good deal to do with its behavior. Thus a line which has considerable leakage uniformly distributed throughout its length will suffer very little from electrostatic induction, either manifested as a disturbance or as a retarding agency; not because the electrostatic induction is not exercised, or is not present (or to put in a more modern and I think a more correct phraseology), not because inductive circuits are not formed, but there being by virtue of the leakage or poor insulation an opportunity for a number of short cut or cross conductive circuits, these are utilized for the conduction of the electricity, permitting the establishment of equilibrium or discharge, at the expense of the utilization of the inductive circuits which tend to retain charge. The phenomena exhibited is comparable to a gallon vessel, say, in which liquid may be poured, but which has a number of holes bored through its sides. The vessel has a capacity of one gallon, but being leaky does not hold its charge, and the said charge is dissipated as quickly as it is formed. In this case, leakage tends if accentuated, to become the chief adverse agency, as not only does a leaky circuit dissipate induced charges quickly, but it also permits stray currents, which may disturb, to come on the lines from external points.

As a matter of fact the several disturbances upon telephone lines are due to a large variety of causes. It is customary to say that the telephone is an extremely sensitive electroscope or galvanoscope, and that it will take cognizance of almost infinitely small currents. This statement, however, should be made with some reservation.

The more correct statement is, of course, that the telephone is a sensitive indicator of *changes* in electrical currents.

A current may be caused to circulate through its helices, which is sufficiently strong to make them warm, but if that current be steady it will not be able to produce a sound in the telephone. Telephone disturbances, then, broadly stated, can result only from changes which occur in the electric condition of the circuit within which the telephone is included, and these changes may be produced by conduction from other electrical organizations; by electro magnetic induction, sometimes brought about by changes going on in substantially parallel circuits, and sometimes caused by the mechanical motion of the disturbed circuit itself in a magnetic field, as when a line swings across the magnetic meridian of the earth, and by the successive charges and discharges, which cause the alternate completing and disrupting of electrostatic inductive circuits.

If we exhaustively examine the literature of the subject we shall find that the idea that electrostatic phenomena are concerned in disturbances of telephone and telegraph circuits, is by no means new. Mr. Culley presented a paper once upon this subject before the Society of Telegraph Engineers; which paper, together with a most instructive discussion, is published in the journal of that society, and Mr. Preece and myself from time to time have also repeatedly referred to it. It is due, however, to Mr. Carty to say that his considerations and researches in this line show him to be an original and independent thinker and observer, and that I have found his work to be instructive in the highest degree.

I think while he is undoubtedly right in attributing a large share of inductive disturbance in telephone lines, that he does not give sufficient weight to the equally undoubted fact, that electro-magnetic induction is also an important factor; and that as I have already pointed out, the conditions of any individual circuit largely govern its action. An interposed plate or an envelope of metal between the disturbed and disturbing circuits, will, if sufficiently thick, and if united to earth, screen so much of the induction as is electro-static in its origin; but it will not screen electro-magnetic induction; and thus whenever it is worth while the sources of inductive disturbances can be analyzed. And while the inductively neutral metallic circuit—the circuit with two wires closely adjacent and twisted together—is indeed a specific against electro-magnetic inductive disturbance, it also tends to increase the retarding effect of electro static induction exercised between the two wires of the circuit.

Some of the considerations which tend to delay the universal employment of metallic circuits in telephony are, however, that there are an immense number of wires even when but one is used to a circuit; that twice the number of wires means twice the number to get out of order, to cross, break and leak, and consequently twice the number to take care of, and handle.

I hardly think that sufficient thought is given to these matters by many who talk glibly about the necessity and essentiality of using metallic circuits only, for all classes of telephone work.

In conclusion I wish to suggest that, inasmuch as the telephone only notes electrical changes, we cannot accurately say that sounds can be produced in it by electrostatic charge.

It is the fact that it is the motion caused in the act of forming and dissipating charge that produces the disturbing sound. But a charge in the act of formation or dissipation is practically a current, and as a current in the act of change it necessarily varies also the magnetic field constituted by the circuit within which it is circulating; and as a further consequence, therefore sets up in an adjacent and disturbed circuit electro-magnetic induction currents. Thus the disturbing action is a compound one; operating first by the successive inductive charges and discharges induced in the disturbed circuit by the changes occuring in the disturbing circuit; and, secondly, by elec-

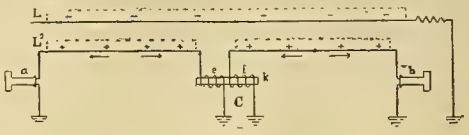

FIG. 11.

tro magnetically induced currents developed in the disturbed circuit by changes in the magnetic field constituted by the disturbing circuit.

National Electric Light Association.

The executive committee of the National Electric Light association has elected John W. Beane of Brooklyn, secretary and treasurer of the organization in place of Allen R. Foote, whose resignation will take effect April 1.

Tuesday, Wednesday and Thursday, August 25, 26 and 27 1891, were fixed as the dates of the next convention to be held at Montreal, Canada. The headquarters of the association will be at the Windsor Hotel. It is probable that arrangements will be made for an electrical exhibit to be open the entire week.

The following committees were appointed: Amendments to the constitution—Geo. B. Shaw, chairman; Marsden J. Perry, Hon E. A. Armstrong. Underground conduits and conductors—M. J. Francisco, chairman; T. Carpenter Smith, A. M. Robertson, John A. Seely, M. D. Law. Finance—John A. Seely, chairman; E. F. Peck, H. H. Fairbanks. Transportation—Mr. Edgar, Montreal, chairman; C. O. Baker, C. A. Brown, Henry D. Stanley, A. J. Corriveau.

Union Pacific Telegraphers.

A dispatch from Omaha, Neb., says: GrandChief Thurston, of the Order of Railway Telegraphers, is in the city consulting with L. H. Korty, superintendent of telegraph of the Union Pacific railroad, with regard to the misunderstanding which exists between the company and some of the operators who are members of the order. Superintendent Korty stated that the company had no prejudice against the order, and had not discharged any operators on account of being members of the order; that every operator who had been discharged had been implicated in the plot to make trouble on the road. Some of these men had been members of the Order of Railway Telegraphers, but this fact had nothing to do with their discharge. Chief Thurston stated that he was convinced that the whole trouble arose from a misunderstanding between the company and the operators; there was no probability of a strike, but that some of the men on the western part of the Union Pacific had been indiscreet and had assumed too much authority. He felt confident that the matter could be amicably adjusted."

The Pontoosuc Woolen company of Pittsfield, Mass., will spend $40,000 for an electric light plant.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 21.—The consolidation of the two electric light companies of Brooklyn, the Citizens' and the Municipal, is practically effected. The former furnished lights to the city proper and the latter to the eastern district. The capitalization of the new company is $2,000,000, half of which the stockholders have a right to subscribe for at par, the old companies representing only a half million each. Stock of the old Municipal is quoted at 135, which is a rise of 15 points in two weeks, and this increase is said to be due to the action of the "bosses" in buying all the stock in sight. The political ring which owns the Citizens' Electric Illuminating company is back of the present purchase of stock of the Municipal company, and it is believed that the consolidation will result in an increase in the price of electric lights. There is no other company in the city in a position to supply lights. The Brooklyn Electric Light & Power company has been steadily refused permission to open streets and lay conduits by the aldermen, who alone can grant a charter, right in the face of the fact that the company offered to supply lights at one-half the price now paid to the Citizens' and Municipal. The appropriation for street lighting is over $400,000 for the current year, and each light costs the city $182.50 a year, and is likely to go up to $200 under the new deal.

At the meeting of the Board of Electrical Control additional streets were named for the building of subways. The work must be completed by June 1. A report concerning unsafe poles was presented by Engineer Kearney, but he thought that there was no danger for a few weeks until the subways were completed, when the poles will be removed. The French Cable company was ordered to transfer its wires to that side of St. Nicholas avenue which is used by the fire department wires. Mr. Kearney reported that there are four distinct sets of poles along Fourth avenue, which is entirely covered by a subway from Seventeenth to Thirty-second street. In a letter which Mayor Grant sent to the police commissioners, he says:

"The Board of Electrical Control has rules to prevent this, but it is impossible to enforce these regulations without the co-operation of the police force. One of the employes of the board recently found a large coil of cable in the Star theater, which the American District Telegraph company intended to string over Broadway by night This company, as well as several other companies, has refused to recognize the authority of the Board of Electrical Control and to comply with its regulations. I ask that you have the police force instructed to arrest any men stringing wires or erecting poles, unless they can produce a permit from the Board of Electrical Control, and to have a careful watch kept that no wires are secretly hung by night by the corporations above referred to until they have complied with the rules of the Board of Electrical Control"

The State Board of Railroad Commissioners has approved of the application of the Harlem bridge, Morrisania & Fordham railway for a change of motive power from horse to electric. The overhead single trolley system will be installed. A question arose as to the consent of the property owners, inasmuch as on Boston and Tremont avenues, a majority of owners did not consent to the change. Treating the route as a whole, the company has over a majority, and the board submitted the question to the attorney-general, who decided that "while the consent of your board is necessary in order that the change proposed may be made at all, the giving of it does not in the least destroy or injure the rights of property owners interested. The corporation can obtain no right to change its motive power without complying with the law, and if I am right in my construction, it has complied."

The board says that with the exception of Third avenue and a portion of Boston avenue the streets on which the road runs are not thickly built up. Long distances intervene where there are few houses, and where it is evident that more rapid means of transit than that furnished by horses would be most desirable, not only to those who live there now, but to those who would be induced to live there were such adopted.

At the annual nominating meeting of the Electric Club, Tuesday evening, March 17, officers for the ensuing year were nominated as follows: President, O. E. Madden; vice-presidents, Samuel Insull, Chas. W. Price, Erastus Wiman and W. D. Sargent; secretary, Franck Z. Maguire; treasurer, Geo. B. Coggeshall; board of managers, H. L. Shippey, Dr. I. B. DeLery, P. H. Alexander, H. D. Cheever, T. C. Martin, C. D. Shain, C. L. Stump, Joseph Barre, E. F. Peck, C. O. Baker, Jr., E. E. Bartlett, H. D. Stanley, J. H. Herrick, committee on membership, C. H. Barney, George T. Manson, J. C. Chamberlain, S. S. Wheeler, Joseph Wetzler. The annual election will take place April 16

At the regular monthly meeting of council of the American Institute of Electrical Engineers, March 17, the following associate members were elected: Adolph G. Greenberg, Fort Wayne Electric company, New York City; Walter E. Harrington, Atlantic City, N. J., Electric Railway; George W. Tuttle, Sawyer-Man Electric company, New York City. The meetings of council are now held at 5 instead of 7 P. M. on the third Tuesday of each month, the same dates as the monthly Institute meetings. The change of hour proves to be very satisfactory.

W. H. T.

Cincinnati, O.

CINCINNATI, March 21.—The Jones Bros. Electric company, formerly in the electrical supply business and manufacturers of telegraph and telephone instruments and annunciators, has extended its operations under the new organization. In addition to its old business the company has engaged in electric light and motor work on a large scale. The station, at present in charge of Isaac Bogart and J. Sweeney, is equipped as follows: Two McIlvain & Spiegel tubular boilers of a combined capacity of 350 horse power, Hoppes' Heater and Cope & Maxwell pumps, one 200-horse power Hamilton-Corliss engine, one 135-horse power Beck engine, four 600-light 120-volt Mather dynamos, two 60-horse power 220 volt Mather generators for motor circuits, one Jones Bros.' 400-light 110-volt dynamos and their own make switch-board. They use the Perkins Lamp exclusively for station work. The company has just added $50,000 to the capital stock, and will make additions to the plant at once. One 300-horse power Sterling water tube boiler, one 200-horse power Porter Allen engine, Cope & Maxwell pumps and three 650-light 120 volt Mather dynamos will be installed, giving a total capacity of 5,000 16-candle power lamps and 120-horse power for motor circuits. Their constantly increasing business and additions have compelled them to make additional accommodations, and workmen are busy now fitting up handsome offices.

G.

Kansas City, Mo.

KANSAS CITY, March 21.—The stockholders of the Gill-Alexander Electric Lock company held a meeting at their offices on East Fifteenth street this week. The officers elected were: Robert Gilham, president; W. W. Alexander, vice-president; M. C. Gilham, secretary and treasurer. The company has a capital stock of $300,000. Among the prominent local men who are stockholders in the company are Ed. F. Swift, R. R. Conklin, S. M. Jarvis, H. P. Churchill, J. W. and F. K. Hoover and James Lillis.

L. A. Palmer, a mechanical engineer, is endeavoring to establish a municipal electric light system. He proposes to light the city to its utmost limits, displacing the present electric, gas and gasoline lamps and at the end of a certain term of years deliver the entire plant to the city, the compensation being the sum—about $95,000—now paid every year for light.

City Engineer Butts has just completed a set of maps showing the details of the present lighting system, and with the aid of these Mr. Palmer is to district the city, determine exactly the number of lights required and the amount of wiring to be done, after which he will make the city a formal proposition. The number of years which the city will be asked to pay for the operation of the plant will depend upon the result of the calculations, the expense of wiring being the present uncertain factor.

The plant if established will cost $235,000. The promotor of the enterprise has held conferences with several of the city officials and his plan has aroused much interest.

Several carloads of rails for the West Side electric line arrived from Pittsburg, Pa., this week and a large force of men was placed at work at once laying them. At a meeting of the council to-night an ordinance granting the West Side railway company a franchise to erect the poles between the double tracks in the center of the street will be disposed of. If the ordinance fails to pass then the company will begin erecting poles along the curb line on both sides of the street.

At present there is a force of 200 men at work on the construction of the line, and the foreman expects to double the force shortly. The company has until May 1 to complete the line, and if necessary a force of several hundred men will be placed at work nights. All the machinery and eight motor cars have been ordered for the line.

The Postal Telegraph Cable company, the Kansas City Electric Light company and the board of public works are the parties to a little dispute about the pole line on Eighth street that the Postal uses. The board of public works holds that the company had no authority to locate the poles. The Postal traded a line of poles on Twelfth street for the one on Eighth street, the superintendent of streets, Mr. Callahan, approving the trade. The people on Twelfth street wanted the electric light and as the telephone company had poles on one side of the street the electric company made a trade with the Postal.

J. F. Herza, assistant superintendent of construction of the Postal Telegraph Cable company, is in the city looking after the company's new wires, which are coming in over the Maple Leaf. This will increase the company's facilities considerably by giving two new routes to the East.

The committee appointed by the Builders and Traders' exchange to inquire into the necessity of a city electrical inspector has made an inspection of the wiring of the principal buildings of the city and its report is complete and comprehensive.

It is the opinion of the committee that the city should have such an inspector and that he should not only look after the wiring of public and private buildings, but see that the streets are properly wired as well. If such an office is created, the person holding it, together with the superintendent of buildings and the chief of the fire department, could form the board of electrical control for Kansas City. Then an ordinance should be introduced in council requiring the proper wiring of buildings.

P.

Detroit, Mich.

DETROIT, Mich., March 21.—W. A. Stadleman of the Electrical Engineering & Construction company, Philadelphia, has been appointed district agent by the Detroit Electrical works for a territory covering the states of Pennsylvania, New Jersey, Delaware, Maryland, Virginia and West Virginia, with headquarters in the Quaker city.

The Rae motor has assumed such prominence that for some months the building of these motors and the installation of railway plants by the Detroit Electrical works has forced other departments in the background. This establishment is one of the largest manufacturers of general electrical supplies in this country. This branch has grown so rapidly that a very large addition to the present plant has been determined upon. Plans have been drawn and a part of the contracts let for new buildings that will cover, when completed, in connection with the present works, an entire block of ground. These shops will be among the largest and probably the best arranged for general electrical work in the United States. Every piece of machinery known to modern electrical mechanics will be provided, and no money spared in perfecting the details. An engineering department is maintained with a large amount of work under contract, the most important of which is the wiring of all the Pullman cars built in Detroit.

Among recent contracts made by the railway department are the following: Lincoln, Neb, Street Railway company, 10 cars, standard 30-horse power Rae motors, McGuire trucks; Eau Claire, Wis., Street Railway, Light & Power company, 2 cars standard 30-horse power Rae motors, McGuire trucks; Salem, Mass, Naumkeag Street Railway company, 2 cars, standard 30-horse power Rae motors, Bemis trucks, to be followed by 8 more if satisfactory; Newburyport, Mass., 2 cars, standard 30-horse power Rae motors, Bemis trucks; Augusta, Me., 2 Rae motors to be used in connection with old road already in operation; Kansas City, Mo., the West Side Railway company—a new road just being built—one 80,000 watt generator, 6 cars, standard 30 horse power Rae motors, McGuire trucks. Mr. Benton, the manager of this department, has also a large number of contracts practically closed, which, taken in connection with those already secured, will make a very active and profitable season for this company.

Brownlee & Co. are arranging their new pole yard on the river and getting in a large stock for the approaching season's business. This firm has just sold 1,800 very large 30-foot cedar poles to the Lincoln, Neb., Street Railway company, the greater part of which order has already been shipped. They have also recently shipped two carloads of pins and cross arms to El Paso, Tex., to be transferred to the Mexican railways and by them to be delivered to the Mexican government. Brownlee & Co. report an active inquiry for their poles and predict a very large season's business.

The Shawhan Machine works have their new generator completed and are now building the following sizes: One hundred, 150, 200 and 250 lights' capacity. These generators will have a high efficiency, besides many new and important features. Each machine is to be provided with a square shaft for the driving attachment, self-oiling bearings, a new style of commutator, besides many other novel features.

The Commercial Electric company has secured a number of contracts for the National Transformer system and

for the Sperry arc lamp. An addition of 1,000 lights is now being made to a central station plant in Kalamazoo, and contracts for two or three isolated plants in the northern part of the state have just been signed. The gentlemen connected with this establishment are wide-awake and energetic.

The Michigan State Senate has passed a bill providing that at crossings of the tracks of two street railways the car of the line first laid shall have precedence, and be entitled to the right of way. It was unsuccessfully opposed by Senator Park of Detroit, as giving the Detroit Street Railway company certain exclusive rights.

The superintendent of the Cable Street Railway in Grand Rapids has recommended, after a thorough investigation, that the company remodel its whole system, abandon some of its lines and throw out the cable system entirely, adopting electric motors in its place. The cable system represents an investment of probably over $2,000,000, the cost of building the road being upward of $70,000 per mile and controls 22 miles of road. Mr. Chapman, the superintendent, is a practical cable road man, formerly of Kansas City. It is estimated that it will cost $700,000 to rebuild the line. F. W. G.

Pittsburg, Pa.

PITTSBURG, Pa., March 20.—Pittsburg has an electric club. It was formed last night and officers were elected as follows: President, Morris Mead; treasurer, James A. Rutherford of the Westinghouse Electric & Manufacturing company; secretary, J. E. Hall of the Fort Wayne Electric company; board of directors, H. McL. Harding, D. W. Dunn, I. H. Silverman, E. B. Kittle, H. E. Dillon, E. Ingold, E. B. Gawthrop. The organization will be social as well as scientific, and convenient quarters will be obtained for the club rooms.

For a long time the management of the Allegheny County Light company of this city has been looking for a site to which the light plant might be conveniently removed. The company at present occupies a space of 80x90 feet right in the heart of the city, and while this is a very convenient situation, the place has long since proved a great deal too small. The company operates now about 35,000 incandescent and nearly 1,000 arc lights. The dynamos, engines and boilers for this capacity of lights had to be placed in this building alone. The result has been that the company found itself greatly cramped for room. The power house had to have additions of flooring, and while this gave the plant more space it did not add to the convenience of the operation. The enormous increase in the demand for electric illumination in this city never made these additions to the plant in the way of floors more than temporarily satisfactory, and the company was at last forced to look around for a site where it might put up a building large enough to suit its purpose. This it has apparently accomplished, securing a piece of property 300x100 feet at the corner of Etna and Twelfth streets, this city. This situation is central, close to the river, and it will give the company an opportunity to put up a building large enough to suit its wants.

It is proposed to make the preparations for the removal as soon as possible, and the company expects to go into the new home not later than next October.

The old Squirrel Hill Electric railroad, which was sold some time ago, and which has since been named the Schenley Park & Highlands electric railroad, is now being rapidly pushed. T. H. Noble, the president of the road, has promised the visitors to Schenley Park that the line from Oakland to the park shall be in operation in less than six weeks. Power for the road is to be obtained from the generators of the Duquesne Traction company. At the opening only three cars are to be run, but as soon as the park becomes an attraction for the people that number will be increased. E. H. H.

Milwaukee, Wis.

MILWAUKEE, Wis., March 21.—All the stock of F. E. Hinkley of Chicago, in the Milwaukee Electric Railway has been attached by the sheriff on a judgment for $12,000 secured by the Thomson-Houston Electric company. Hinkley has already lost control of the road, and a judicial sale of his stock will dispose of him altogether. It is generally admitted that Pfister will soon have absolute control of the property. Hinsey and Hinkley are now fighting for the crumbs that Pfister leaves. Just at present the matter of appointing a receiver is the point at issue. All parties concerned agree to this step, but the selection of a person to fill the position is still a matter of dispute.

The ordinance to regulate the speed of electric cars to three miles an hour at street crossings will be killed in the common council. Most of the aldermen are opposed to the measure. They state that horse cars travel six miles an hour over street crossings, and that rapid transit would be a hollow mockery were electric cars limted to a speed of three miles an hour at street crossings. The disposition is not to limit the electric railway companies in the matter of speed, but to allow them to make their own regulations and pay whatever damages may be secured.

The Wisconsin Telephone company will take possession of its new home on Broadway about May 1st. Although the company has been limited by its site, which is 25 by 120 feet, it is claimed that the exchange will be the finest in America. The company originally intended to put up only a four-story building, but after the erection of a six-story building on the lot adjoining the exchange was begun, it was decided to make the exchange five stories high. However, the adjoining structure still towers forty feet above the rear part of the exchange, and as a measure of protection the company has erected a system of steel braces, so that the higher wall will not fall upon the exchange in case of fire. Every floor and partition in the exchange is constructed of steel beams and hollow tile, and the hottest kind of a fire could not spread from one room to another. The building is considered absolutely fire-proof. The front exterior is very quaint. It is of ornamental tile, and totally unlike any exterior in the city, the tiling being something new in building material. With the clay of which the tiling is made, a small proportion of copper is mixed, giving the tile a peculiar mottled appearance.

Electric elevators are being introduced in Milwaukee. There is to be one in the new telephone exchange, another in the new Adler block, on East Water street, and several more are expected to be used in other buildings.

The West Side Railroad company's Twelfth Street line is to be extended north to the city limits and east to the base ball park during the spring.

The National Home & North Greenfield Railway company will not offer any objection to the Milwaukee Street Railway company's project of extending its line from the Soldiers' Home to North Greenfield if the Villard people will give satisfactory assurances. In fact, the incorporators of the former company and other North Greenfield property-owners are willing to pay the Milwaukee company a bonus for building to that suburb. The government has formally granted the Milwaukee Street Railway company the right to build into the Soldiers' Home grounds and the company will undoubtedly push work on that line as rapidly as possible. The distance between the Soldiers' Home and North Greenfield, which is a growing place, is a little over two miles, but the intermediate country will materially aid in the support of a street railway, and it is probable that the Villard syndicate will build to North Greenfield.

In the legislature the committee on corporations has reported against the bills to require telephone companies to put in return metallic circuits and there is little doubt of the measure's being killed. In Milwaukee, since the introduction of electric cars, considerable trouble has been experienced from induction. One of the methods used to avoid trouble, was to connect fifteen or twenty subscribers together with one steel wire as a return wire between them, instead of using the ground wire. But this was only a partial success. Now the company is providing each subscriber on the underground district with a return circuit, but an extra charge is made for the service. C.

ELECTRIC LIGHTING.

The establishment of an incandescent electric light plant at Sumter, S. C., is proposed.

It is said that about $15,000,000 is invested in electric lighting enterprises in London.

The mayor of Richmond, Va., recommends that the city establish an electric light system.

An ordinance has been introduced into the East Portland, Ore., city council, providing for bonding the city to erect an electric light plant.

The St. Louis council committee on public improvements has recommended the approval of the bond of the Carondelet Electric Light & Power company of $20,000, with John Krause, O. A. Haynes, F. W. Mott, R. J. Kilpatrick and Wm. H. Hallett as securities.

The Electric Tramway & Lighting company of Victoria, B. C., has started up its lighting plant, which consists of two 650-light Thomson-Houston alternating current dynamos. A number of the Thomson-Houston alternating current lamps are in use in that city.

The new electric light plant for the city of Lowell, Mass., is said to be one of the largest in New England, and it will soon be in active operation. Its location in Belvidere is only a short distance from the heart of the city. The new station is designed for 3 000 horse power, and already 1,200 horse power is installed. It covers a total area of 211 feet in length, 93 feet in depth, or about 20,000 square feet.

C. B. Hurley is quoted by the St. Louis *Globe-Democrat* as follows: "The day will soon come when electricity will be used for lighting, heating and motive power, to the utter exclusion of the old methods. If any one had told me ten years ago that I would be sitting to-day in a hotel lighted with electricity, I would not have believed him. When I was in college, fifteen years ago, one of my professors, an exceptionally able man, reprimanded me severely for not attending an exhibition of a new phonograph. Look what it is now! In 1883, after an absence in Mexico, I returned to New York, and found it lighted with electricity. I thought it the most wonderful thing I ever saw."

ELECTRIC MOTOR.

The Eddy Electric Manufacturing company has just closed a contract with the American Encaustic Tiling company, limited, of Zanesville, O., for an electric power transmission plant aggregating 365-horse power. The dynamos will be 90-horse power each, and the motors will range in size from 10 to 35 horse power.

G. A. Edward Koehler, Chicago representative of the Eddy Electric Manufacturing company has installed a 25-horse power motor in E. Smeeth's manufacturing establishment, Chicago; a 1-horse power motor for the Chicago Blue Print Paper company; a 5-horse power motor for S. W. Packard to operate an elevator at 296 Wabash avenue, and a 3, a 5, and a 7½-horse power motor for operating ventilating fans in the Chicago Daily *News* establishment.

ELECTRIC RAILWAYS.

An electric railway is to be built at Sandusky, O.

An electric railway will be built at Boise City, Idaho.

A new electric street railway is in operation at Hayward, Cal.

It is said that Denver, Colo., has 49 miles of electric street railways.

The Terre Haute, Ind., street railway people will introduce electricity.

The Kokomo, Ind., Electric Street Railway company will erect a power house.

Track laying for the suburban electric railway of Denver, Colo., has already commenced.

Local capitalists are forming a company to build an electric railway at McKeesport, Pa.

The Brooklyn City Railroad company is contemplating the use of electricity as motive power.

The Ottawa Electric Street Railway company, capitalized at $500,000, has been incorporated.

It is reported that the Atlanta, Ga., Street Railway company will use electric motive power exclusively.

The Tacoma & Puyallup railway, 14 miles long, will probably be equipped with storage battery cars.

It is stated that the new electric railway from Charlotte, N. Y., to Manitou Beach will be equipped with Rae motors.

Memphis, Tenn., is to have an extensive system of electric street railways. The Thomson-Houston system will be used.

The Baltimore, Md., Union Passenger Railway company has filed an application for permission to use electricity on its lines.

The electric railway companies of Bay City and West Bay City, Mich., have each appointed a committee to consider consolidation.

At Iowa City, Iowa, a company has been granted a franchise to operate electric cars. The generators will be run by water power.

The people of Sacramento, Cal., are delighted with the new electric cars. It is proposed to operate at a speed of twelve miles an hour.

The Edison General Electric company has contracted for the construction and equipment of three miles of electric railway in Savannah, Ga.

It is estimated that the change from mule to electric power will cost the Citizens' Street Railway company of Memphis, Tenn., $1,000,000.

At Fort Rouge, Man., a new electric street railway is in operation. It is notable as being the first in Canada to be operated on the Edison system.

It is claimed that the largest electric street railway plant that the Westinghouse company has yet put in any town is at Springfield, Mo. It is seventeen miles long.

The State Electric Street Car company of Clinton, Ia., has closed a contract for the construction of its road. The line is to be five miles long.

The Citizens' Street Railway company of Pine Bluff, Ark., has increased its capital stock to $200,000 and will change its line to an electric railway.

A Quincy, Ill., paper says: "The electric lines have done more to give Quincy a metropolitan appearance than any enterprise we have had for many a year."

Capt. J. H. Barnard and E. S. Hawks have purchased the Wilmington Street Railway, Wilmington, N. C. It is four miles in length and will be converted into an electric road. The line will be extended about five miles

The employes of the Electric Motor company in Newark, N. J., have organized a Mutual Benefit and Aid association, which they will invite all of the employes of the electric roads throughout the country to join. The object of the order will be the mutual benefit and improve-

ment of the employes of the various roads throughout the country.

The Electric Traction company of New Orleans, La., is equipping the Coliseum line with storage battery cars, several of which are already in operation, and have proved very satisfactory. The contract calls for the equipment of twenty-two cars

An electric railway was started at San Jose, Cal., February 24. The Thomson-Houston system was adopted, and on the trial trip everything was found to be in perfect working order. The opening was attended by the mayor and city council.

The Findlay, O., Street Railway company has increased its capital stock from $150,000 to $200,000, for the purpose of operating the Main Street line by electricity Contracts have been let, and the work will be completed within sixty days.

A party of Denver capitalists has completed arrangements for the purchase of franchise, real estate and equipments of the Salina, Kan., Street Railway company and will change the line into an electric line, making a double track road. A subsidy of $50,000 in real estate will be donated.

The Portland & Westbrook Street Railway company of Westbrook, Me., has been organized with a capital stock of $300,000, and is preparing to construct electric or horse lines from the village of Saccarappa, in the town of Westbrook, through Cumberland Mills and Deering, into the city of Portland.

The quarterly statement of the Rochester Street Railway company shows an increase in the earnings of the company for the last quarter of 1890 over that of the previous year of $4,634.04. During the last year the company has equipped several lines with electricity and will continue until all its lines are thus equipped.

A very complete test was made over all the Liverpool tram lines with an accummulator car some months ago. The result of this testing seems to have been satisfactory, and a new steel underframe car is now in course of construction for actual use on the Liverpool roads. The car will be fitted with two motors, one on each axle.

An act to incorporate the Fall River Electric Freight Railway company has been introduced in the Rhode Island senate. The line is to begin at a point in the boundary line between Rhode Island and Massachusetts, near the Shove Mills, and run southeast, skirting the shore of Laurel Lake, to the boundary line, with eight rods way. The road is to be used for freight only. Nathaniel B. Church, William J. Brightman and Timothy W. Sprague are mentioned as three of the incorporators. The capital stock is placed at $5,000,000.

The demands of the people of New York in the matter of rapid transit are thus presented by the *Sun:* "We want more trains and faster trains to come down in the morning and go home in the evening. And we want a seat now and then without having to fight for it, or swing from a hand strap. There is nothing so slow nowadays as real rapid transit. Trains are slow in coming, and slower than ever when they arrive. But if the public will take a hand in the matter and let its voice be heard, we shall have reform and relief, and have them quickly." The only permanent relief that the city of New York can secure is by adopting an electric system

A dispatch from Albany, N. Y., gives a graphic description of the storm in that city, March 9th, and its effect on the electric wires. The storm caused one of the most vivid illuminations ever seen in Albany. At the corner of Broadway and State streets the wires of the electric street railway fell across the network of Western Union and telephone wires and lighted up the streets for half a mile in every direction with continual flashes. Long festoons of the wire, all aglow with dull smoldering red, fell to the ground. Live wires dropped down on the car-tracks, which were instantly turned into lines of dazzling brightness Showers of sparks fell in all directions and at times seemed to spring up in jets from the earth. For a moment there would be darkness and then the whole street would be lighted up so that the smallest signs on the houses could be read. All this lasted for fully ten minutes, at the end of which an alarm of fire was sounded. The crossed wires had burned out the switch-board in the telephone exchange, which cost $23,000 and was burned out by a similar accident a little more than a month ago.

ELECTRIC MINING.

The organization of a company to exploit the electric hoisting and conveying of machines devised by Ezra Nicholson of Cleveland, O., is announced. The invention is especially adapted for the economic handling of coal, ore and general merchandise, conveying the load to any desired point. It will hoist a load of 3,000 lbs. 5 feet per second.

According to the returns to the census department, just completed, there were during the calendar year 1889, 26,464 flasks, or 2,024,496 pounds of quicksilver produced in California. About 20 flasks, less than $1,000 in value, were produced in Oregon. The product is notably less than the usual yield. In 1888 33,250 flasks were produced.

Manufacturers of electric mining machinery will be interested in the bulletins issued by the census department. John H. Jones, special agent in the coal department, J. B. Randol in charge of quicksilver, and Dr. William C. Day, special agent in charge of stone, have prepared reports under the direction of Dr. David T. Day, giving valuable statistics in these special lines.

The development of coal mining in Alabama during the last ten years has been almost phenomenal. Mining of coal was begun in that state about the year 1853. The total output was produced mainly by small operators for local consumption, and did not reach 100,000 tons until the year 1876. The production for the census year 1880 was 323,972 tons, valued at $476,911 at the mines. According to the official report the product for the calendar year 1889 was 3,378,484 tons, valued at $3,707,426. The average number of persons employed during the year, including superintendents, engineers, mechanics and the clerical force, was 6,762, and the amount of wages paid was $3,175,356. These figures apply exclusively to the mining of coal and preparing it for shipment, all expenditures for the manufacture and handling of coke being excluded. The coals of Alabama embrace all the bituminous varieties, such as gas, coking, block, splint and cannel. There are forty-four regular and twenty-two small mines for local consumption. There were 2,266,839 tons loaded on cars and boats for shipment, of which 1,868,596 were delivered for consumption within the state. The average price received was $1.10 per ton.

Electrical manufacturers generally will be interested in the figures presented by Dr William C. Day, special census agent, in his report on mining slate, to Dr. David T. Day of the geological survey. The greater part of the product of the American mines is used for roofing purposes, but of late the demand for slate for insulating purposes in the manufacture of electrical devices has rather stimulated the business. There are 206 slate quarries in the United States, of which 104 are in Pennsylvania. Vermont has 60 and New York 16. Maryland and New Jersey have 5 each, Georgia and Maine 4 each; Virginia, 3; California, 2; and Arkansas, Michigan and Utah, 1 each. That in Utah, however, was not operated last year. The total value of the production of 1889 was $3,444,863; the cost of the production $2,823,668, including wages of employes amounting to $2,209,344. Over $10,000,000 is invested in these enterprises, including land, buildings and fixtures, live stock, machinery and supplies on hand and the necessary money for operating expenses Some of the facts presented in this report are quite interesting. For instance the quarry at Arkansas represents a capital of $610, divided as follows: land, $500; fixtures, $10; live stock, tools, machinery and supplies on hand, $25; cash, $75. The employes number seven men—one foreman, two quarrymen and millmen, one mechanic and three laborers. The cost of operating the quarry last year is reported as $4,295 and the value of the productions $240. It might be interesting to note that the name of the company and the addresses of its officers are omitted from the list which is appended to the report. This may indicate that the owners did not find it advisable to continue the undertaking. Although New York ranks third in the number of its quarries it does not hold that position in the relative value of the property. Maine which has only 4 quarries, one-quarter the number in New York, produced slate valued at $214,000 while the output of New York was only $130,603 The Maine quarries represent an investment of $641,000 while those of the Empire State are rated at $296,180. The importance of this industry to Pennsylvania may be realized when it is shown that it represents a capital of $6,823,002, and gives employment to 3,567 hands. The wages of these employes amounted to $1,283,530 last year. The total operating expenses aggregated $1,729,163 while the output was valued at $2,011,776. What is known as the Bangor region in Northampton county, Pa., is the most important in the country, including quarries at Bangor, East Bangor and Mt. Bethel. The only red slate produced in the country is found at Washington county, N. Y.

NEW INCORPORATIONS.

Sheldon Electric Light company, Sheldon, Iowa; capital stock, $20,000; to manufacture and sell electric light, heat and power.

Franklin Electric company, Franklin, Pa.; capital stock, $25,000; supplying light, heat and power by electricity to the public at the city of Franklin.

The American Electric & Dynamo company, Denver, Colo.; capital stock, $150,000; to deal in electric motors and all appliances of the same and patent rights thereto.

Mt. Sterling Electric Light & Power company, Mt. Sterling, Ill., capital stock $7,000; to furnish electric light and power to citizens and to the city of Mt. Sterling.

St. Clair Electric Light, Heat & Power company, St. Clair, Pa.; capital stock, $20,000; furnishing light, heat and power by electricity to the public at St. Clair, Pa.

Waverly Electric Light & Power company, Waverly, N Y.; capital stock $37,500; manufacturing and using electricity for light, heat and power and to generate and supply electricity, etc.

La Roche Electric works, Philadelphia, Pa.; capital stock, $100,000; manufacturing, erecting and installing electric light and electric motor machinery and all appliances pertaining thereto.

The Taylor Electric Signal company, Chicago, Ill.; capital stock, $500,000; the manufacture and sale of electrical and mechanical devices and machinery for steam and street railways and other uses.

United States Railway Equipment & Construction company, Chicago, Ill.; capital stock, $100,000; to construct and equip railways; incorporators, William Armstrong, Frank B. Dyche and Lawrence Harmon.

Moberly Gas & Electric company, Moberly, Mo.; capital stock, $30,000; manufacturing and vending gas and electricity for light, heat and power; incorporators: L. M. Rumsey, James Green, George H. Madill, F. A. Baumgardner.

The Mexican Electric company, Jersey City, N. J.; capital stock, $300,000; to manufacture, buy, sell and deal in electrical machines and appliances of all kinds and to erect and operate electric lighting plants

Halson Electric Harness & Supply company, Chicago, Ill.; capital stock, $250,000; to manufacture, supply and sell harnesses and electric devices and appliances for harnesses and carriages, and the leasing and sale of rights and privileges under patents granted for electric devices for harnesses and carriages.

TELEGRAPH.

According to a Cincinnati dispatch a mistake in telegraphing the track betting on a horse in the New Orleans races may be the means of a suit against the Western Union Telegraph company. The mare Maud was entered in the race, with Overton riding her. To the surprise of those gathered in the pool rooms the betting on Maud was wired in as 10 to 1, and the pool rooms gave two points better, making the odds 12 to 1. The "short boys" got on heavy while the plungers stood aghast. For about three minutes these odds stood. Then the betting was cut down to even money. The race was run and resulted in a dead heat between Maud and Bonnie Anna, and in the run-off Maud won. The peculiar thing about the whole affair is that in the betting sent from New Orleans a mistake was made in transmiting over the telegraph wires. Telegrams from New Orleans regarding the races reach Cincinnati by way of New York, and in some way a mistake was made and the odds on Maud were telegraphed as 10 to 1. It is upon this mistake that the pool room proprietors are talking about suing the telegraph company to recover what was lost.

The employment of young and inexperienced operators, says the *Railway Service Gazette*, is an evil that should be corrected. It is asserted that on some roads the operators are nearly all boys, whose salaries do not average over $25 per month. The employment of this sort of inefficient help is largely responsible for a great many accidents that result in loss of life; far more than the public is aware of. If legislative action has not already been directed against the evil, it is not because the public has not been fully advised of its extent. There is the same necessity that the telegraph operator should be a competent, well matured, experienced man, as that the locomotive engineer should possess the qualities named. Salaries of from $150 to $200 a month are paid to engineers. Operators receive from $25 to $50 per month, and as stated above, we have the assurance that on some roads nearly all are boys who receive an average of not over $25 a month. Now, when it once becomes fully impressed upon the understanding of the general public that the boy telegraph operator, sixteen or eighteen years old, thoughtless and careless as boys often are, possibly with little experience and unimpressed by the magnitude of his responsibility, holds in his hands every day and night the lives of thousands of human beings—when these facts once become fully impressed on the minds of the whole people every state legislature in the Union will be grinding out legislation to correct this evil; and while it will be exceedingly difficult to frame any sort of laws to meet the requirement of the case, the railway companies may be made to suffer without corresponding benefits to the public. It would be far better for all interests if the railway managements would forestall legislative action, and by paying reasonable salaries secure a better class of operators.

PERSONAL.

C. A. Benton of the Detroit Electrical Works, was in Chicago last week.

F. J. Cram of the Electrical Engineering and Supply company, St. Paul, was in Chicago last week.

William E. Worthen has been appointed consulting engineer of the Rapid Transit Commission of New York city.

Alex. Lewis was in Chicago last week. Mr. Lewis is now representing the Thomson-Houston company at Cincinnati.

E. E. Higgins, formerly with the Thomson-Houston Electric company, has accepted a position with the Short Electric Railway company.

J. G. Emery, Jr., of the Wilkin Manufacturing company, and A. J. Shaw of the Shaw Electric Crane company, Milwaukee, were in Chicago last week.

G. E. Fish has resigned his position with the electric railway company, St. Paul, and returned to Chicago. It is probable he will make that city his headquarters hereafter.

C. E. Bibber has resigned from the Holtzer-Cabot Electric company to accept the position of general manager of the Consolidated Electric Manufacturing company. He will be succeeded by C. F. Armington.

MISCELLANEOUS.

The annual meeting of the Thomson-Houston Electric company of Boston will be held at Middletown, Conn., April 13th.

It is estimated that the constantly increasing use of electricity will swell the consumption of copper 50,000 tons in England and France this year.

More than 120 new companies connected with electrical engineering were registered in England in 1890. Their aggregate capitalization was upward of $65,000,000.

The London *Electrician* is reminded by the Wesley centennial celebration that the great divine was the author of a work of electricity. This curious brochure was published in 1759, under the title of "The Desideratum; or, Electricity Made Plain and Useful by a Lover of Mankind and of Common Sense." The titles of the sections are

decidedly suggestive—"Electricity the Soul of the Universe;" "The Cat in the Oven, Curious Electrical Experiment;" "A Person with Small Pox Cannot be Electrified;" "Electricity the Greatest of all Remedies." The reverend author goes in for a serious argument to demonstrate that it is "just as innocent to keep our rooms tight from lightning, as from wind and water." One of the entries is as follows: "Exp. 32. A Person standing on the Ground cannot easily kiss an electrified Person standing on the Rosin." About half the volume is taken up with narratives of cures supposed to have been wrought by electrifying, the diseases being of the most varied kind.

TRADE NEWS.

Louis Walsh of the Crosby Electric company will shortly make a tour of the West, introducing the liquid and dry batteries of the company.

George Cutter has added to his line of specialties the rubber insulated screwdrivers and plier handles made by Spinney, Virtul & Co., at Lynn, Mass. Besides carrying quite a stock of these safety devices he also has an extensive line of simplex wire.

The Pennsylvania company for insurance of lives and granting annuities has ordered from the Electro Dynamic company of Philadelphia three series of 58 cells of the "15L" type accumulators, with resistance regulating switches, etc. complete, for lighting its building, 517 Chestnut street, Philadelphia.

In the instructions that accompany the Wirt volt indicators the following appears: "If any one tells you that the indicator fails to agree with his idea of what is correct, send to Johns Hopkins, Cornell or Michigan State University for comparison, at our expense if found 2 per cent wrong and seals unbroken." These instruments are placed on the market by the Electrical Supply company of Chicago.

The Crocker-Wheeler Electric Motor company, New York, will soon enlarge the establishment in West Fourteenth street, doubling the space it now occupies. This will enable it to have a large showroom for exhibiting all sizes of Crocker-Wheeler perfected motors with their various applications in operation, also a dust proof department for the storage of finished motors and motor frames ready for winding. The company finds it necessary to carry a large number of motors unwound for filling special orders.

Manager Mason of the Electric Merchandise company of Chicago is rapidly acquiring an extensive foreign correspondence. A short time since he received an order from Amsterdam, and a few days ago another came in from the Maschinenfabrik of Oerlikon bei Zurich, in Switzerland. The Swiss company is engaged in the construction of electric railways. The librarian of the British patent office writes for one of the Electric Merchandise company's catalogues, stating his opinion that it would be a valuable addition to his collection. Many other letters of like character attest the growing foreign trade of this popular company.

BUSINESS.

The Crosby Electric company has issued a neat advertisement in the form of a "special postal card" in which attention is called to the specialties of the company.

The Sunbeam lamp which the Electrical Supply company of Chicago is handling, is rapidly winning public favor. During the last week several large orders have been shipped.

The H. H. Hipwell Manufacturing company of Allegheny City is removing its entire plant to Long Island City, N. Y., where it has built a new factory, which will be thoroughly equipped with the latest improved machinery for the manufacture of every variety of sheet metal goods. The company also announces that it will manufacture a complete line of electrical supplies and many specialties.

The value of the comprehensive new catalogue of the Eastern Electrical Supply & Construction company of Boston is greatly increased by the carefully compiled index incorporated with it. This company manufactures or furnishes electrical supplies of every description. Beside a complete list of the goods furnished by the company the catalogue contains directions for setting up and maintaining batteries, directions for putting up automatic gas burners and hints regarding wiring and switches.

The Shaw Electric Crane company of Milwaukee will remove its entire plant to Muskegon, Mich., at which place a very extensive plant, arranged specially for the work is to be built. A portion of the contracts have already been let, and it is hoped that the removal can be made early in August. A reorganization of the company has just taken place and the working capital increased to $150,000. Within the last month a 10-ton crane has been sold to McIntosh, Seymour & Co., Auburn, N. Y.; one of five tons to the Standard Elevator company, Chicago, and one of fifteen tons capacity to the Ball & Wood company of New York.

The Chicago Electric Manufacturing company, 73 West Jackson street, Chicago, has taken new quarters on the second floor of the same building. They have equipped their new place with new machinery and they have now every facility for the manufacture of electrical specialties, or for general electrical supplies. The new room is 45x90 feet with a large fireproof vault in which all models and drawings belonging to patrons are placed at night for safe keeping. The floor space is divided into three parts, a small room being partitioned off for grinding and polishing and one for testing purposes, large windows in front and rear giving ample light for all purposes. Large, well arranged hardwood benches are placed against the walls, and the room is literally filled with the best machinery that could be purchased. An increased stock of copper in all forms and insulating materials of different kinds will be carried in stock, so that inventors and model makers can get anything in this line wanted. Among the recent inventions brought out by this company is a sliding contact rheostat. A very large switch has also just been built to be used in connection with the Pumpelly storage battery plant now being put into the Davidson theater, Milwaukee. Mr. Claghorn, the manager, is to be congratulated upon the excellent results thus far attained.

The new Mosher arc lamp, which has been put on the market by the Mosher Arc Lamp company, 125 Ontario street, Chicago, is attracting much attention. Quite a large number are now in use, and they are giving entire satisfaction One of the improvements contemplated is a new carbon that is expected to burn fifteen hours. A new lamp that will work on either high or low tension circuits is also to be brought out. In the construction of the Mosher lamp the use of all clock work and complicated mechanism is completely avoided. A solenoid, a simple clamping device, a regulating spring and a smooth carbon rod constitute the controlling features of the lamp. The carbons are always kept apart when the lamp is at rest by a regulating spring. When in operation the pressure of current through the derived circuit coil forces the carbons together and these two reliable forces operate against each other to maintain a normal arc. The resistance is composed of fine braided wire, inc'osed in a case or jacket.

ELECTRICAL PATENTS.

Issued March 17, 1891.

448,199. Electric Motor Truck. Francis O. Blackwell, New York, N. Y.

448,246. Support for Electric Wires. Charles A. Lieb, New York, N. Y.

448,252. Method of an Apparatus for Determining the Direction of Sounds. Norton P. Otis and Walter H. Underwood, Yonkers, N. Y.

448,260. Motor Suspension for Railway Work. Edwin W. Rice, Jr., Lynn, Mass.

448,271. Electric Type Writing Machine. Edward J. Silkman, Baltimore, Md.

448,273. Electrically Controlled Valve. John V. Stout, Easton, Pa.

The object of this invention is to provide a circuit controller, whereby the danger of waste of the battery is avoided and the operation is rendered certain.

448,274. Electric Temperature Regulator. John V. Stout, Easton, Pa.

The first claim reads:

"The combination, in a regulator, of a thermostatic bar having conducting terminals, a revoluble plate having co-operating contacts, and means for turning said plate, whereby one of said co-operating contacts rubs across one of said terminals and is carried out of the path of movement of the bar and another contact is brought into the path of the bar on its return movement."

448,279. Electric-Lighting System. Elihu Thomson, Lynn, Mass.

This invention relates to a means of automatically regulating the flow of current to a group of incandescent lights, or other translating devices arranged in multiple arc upon a line on which the current supplied is of fairly uniform amount, such as an arc light line or a line of high potential supplying a number of such groups in series.

448,280. Electric Meter. Elihu Thomson, Swampscott, Mass.

448,294. Circuit Closer for Clocks. Henry A. Chase, Boston, Mass.

448,303. Driving Mechanism for Dynamo-Electric Generators. Sidney H. Short, Cleveland, O.

The fifth claim follows:

"In combination with a dynamo-electric generator and a steam-engine for operating the same, driving mechanism rigidly connecting the dynamo with the steam-engine and provided with an insulating-section between the steam-engine and the dynamo."

448 315. Tail Light for Railway Trains. A. W. Berne, New Orleans, La

448,317. Electric Sad Iron. Charles E. Carpenter, Minneapolis, Minn.

448,322. Call System. Louis Digeon, Paris, France.

448,325. Electric Alarm Clock. Edward M. Edgerton, Chicago, Ill.

448,326. Method of and Apparatus for Developing Mechanical Motion from Electrical Energy. Rudolf Eickemeyer, Yonkers, N. Y.

The first claim is given:

"The method of developing mechanical motion from electrical energy, which consists in intermittingly varying the polar condition of an electro-magnetic field and in like manner varying induced polar conditions in a movable element by correspondingly varying separate supplies of field exciting energy derived from any suitable source of electricity."

448,328. Electric Railway. Justus B. Entz, New York, N. Y.

448,329. Telephone. Stephen D. Field, Stockbridge, Mass.

The last claim is:

"A telephone comprising a permanent magnet, an iron box in magnetic connection with the opposite poles thereof, iron pole-pieces magnetically connected to the permanent magnet and opposing each other in the box, said pole-pieces being surrounded by reversely wound coils, and a diaphragm magnetically connected with the box and extending between the pole-pieces."

448,331. Commutator Brush. Karl G. Frietsch, Schenectady, N. Y.

448,338. Segmental Resistance-board. Gideon D. Hand and Osborn P. Sells, Chicago, Ill.

448,351. Electric Arc Lamp. Karl Kurmayer, Vienna, Austria-Hungary.

The invention has for its object to provide means for synchronizing the movement of the carbons in those lamps or lights in which the electrodes are composed of two carbons, to provide means for determining either positively or electrically, or both, the relative position of the electrodes for the purpose of determin the length of the arc, and for the purpose of obtaining an invariable arc when its length has been determined.

448,359. Support for Electric Cables. Henry B. Nichols, Boston, Mass.

448,365. Electric Switch. Ransom D. Pratt, Marlborough, Mass.

448,378. Electrical Street and Station Indicator. Francis H. Soden, Chicago, Ill.

448,392. Barber's Indicator. Simeon P. Watson, Brooklyn, N. Y.

448,395. Insulator. George K. Wheeler, Chicago, Ill.

448,398. Signal Box. John C. Wilson, Boston, Mass.

This invention has for its object to construct a signal transmitting apparatus adapted to transmit several different signals, it being specially applicable for police signaling.

448,399. Signal Box. John C. Wilson, Boston, Mass.

448,400. Signal Box. John C. Wilson, Boston, Mass.

448,401. Apparatus for Ventilating Railroad Cars. Robert J. Wilson, Pittsburg, Pa.

448,404. Process of and Apparatus for Electrically Reproducing Irregular or Undulating Surfaces. Noah S. Amstutz, Cleveland, O.

448,418. Electric Arc Lamp. James W. Easton, New York, N. Y.

The first claim is given:

"In an electric arc lamp, the combination of a brake-wheel controlling the movement of a carbon rod and a spiral spring bearing against the periphery of said wheel, one end of said spring being secured to a fixed portion of the lamp or frame and the other end being connected with the core or armature of a solenoid or magnet, whereby the tension of said spring is varied with changes in the resistance of the lamp circuit."

448,431. Electric Switch. Edward H. Johnson, New York, N. Y.

448,461. Underground Conduit for Electric Railways. Robert A. Stewart, Allegheny, Pa.

448,468. Electric Wire Support and Cut Out. Edwin R. Whitney, Manchester, N. H.

The invention is embodied in a device adapted to be fastened upon the wall or ceiling of an apartment or building for the purpose of holding electric supply wires to the wall of the structure, and also for making electrical connection from the said supply wires to a branch or wire containing a device to be supplied with the electric current from the main supply wire.

448,505. Trolley Support for Electric Cars. Benjamin F. Crow, St. Louis, Mo.

448,523. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

An object of this invention is to provide an electric lighting circuit to light the railway and adjacent parts; receiving electric current from the same generators which supply current to line conductors of the railway, and also using such railway conductors as the lighting circuits.

448,540. Commutator Truer. David McGenniss, Amsterdam, N. Y.

448,541. Process of Making Iodine by Electrolysis. Thomas Parker and Alfred E. Robinson, Wolverhampton, England.

448,561. Electric Railway Motor. Charles J. Van Depoele, Lynn, Mass.

Of the fifteen claims the third is given:

"In an electric-railway system, a number of motors, each having a revolving armature mechanically connected to the wheels of the railway vehicles, said armature being driven by a rotating constant field of force controlled by and rotating at a speed corresponding with the speed of the wheels of the vehicles.

448,562. Electric Locomotive. Charles J Van Depoele, Lynn, Mass.

448,563. Electric Railway System. Charles J. Van Depoele, Lynn, Mass.

448,587. Escapement Device for Matrix Making Machines. Casper L. Redfield, Chicago, Ill.

448,594. Method of Making Plated Wire. Charles R. Smith, Providence, R. I.

448,598. Electric Transportation System. Schuyler S. Wheeler and Charles S. Bradley, New York, N. Y.

448,603. Electro Magnetic Motor. Edwin D. Chaplin, Holliston, Mass.

448,604 Electric Cable. William A. Conner, Pittsburg, Pa.

448,618. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa,

The object of this invention is to provide a construction for an electric railway, wherein a conductor shall be suspended above the railway and adapted to supply current to the electrically propelled vehicle supported upon the track rails of the railway, said rails forming the return circuit of the system, and in which the car is provided with an underrunning contact making a traveling connection with the under and exposed surface of the suspended conductor.

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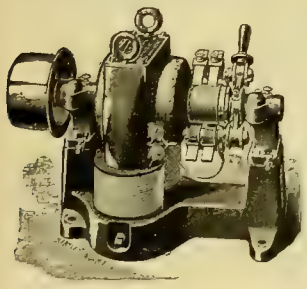

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CHICAGO REFERENCES: Charles F. Brown, Patent Attorney, American Electric Fence Co.

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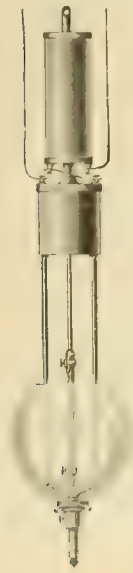

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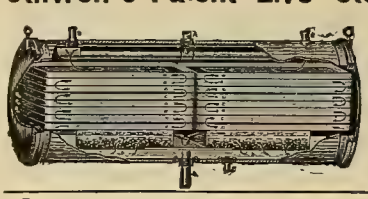

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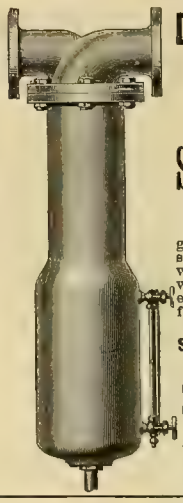

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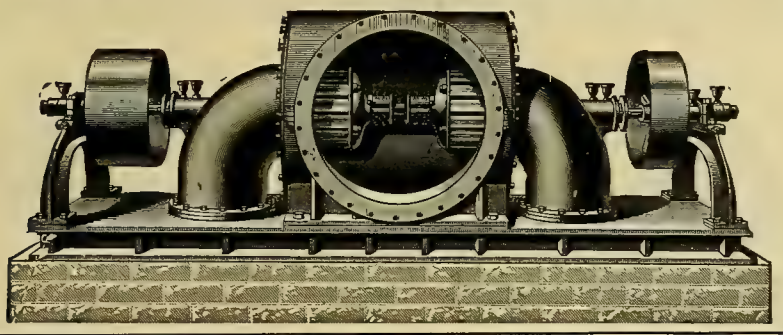

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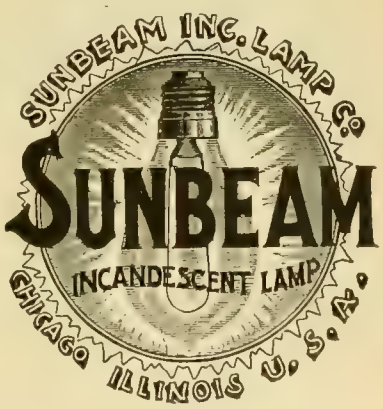

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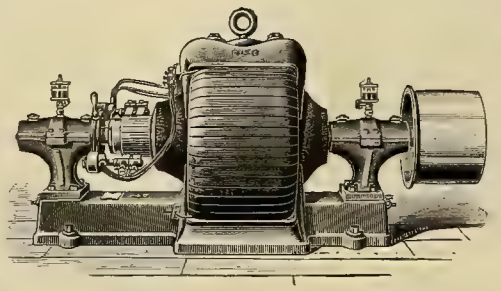

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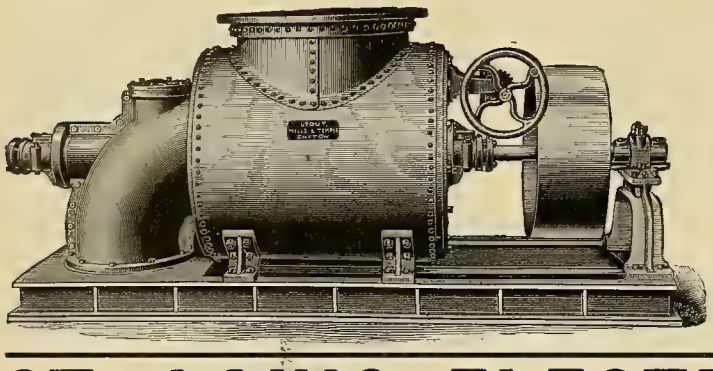

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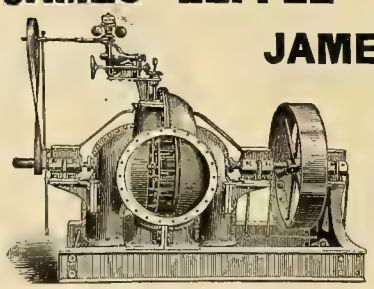

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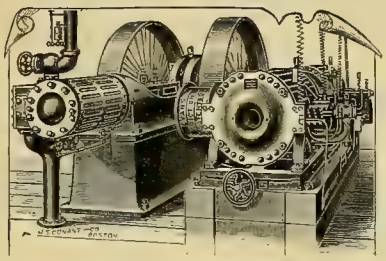

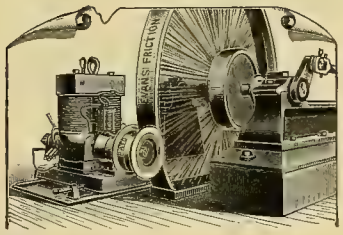

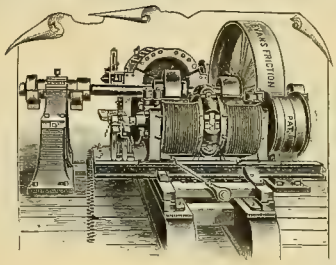

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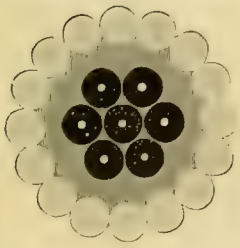

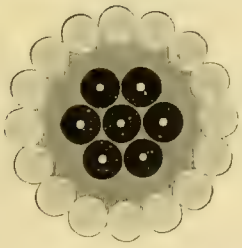

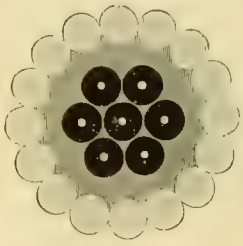

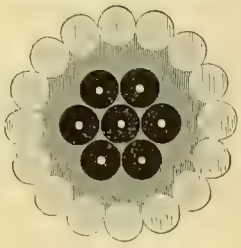

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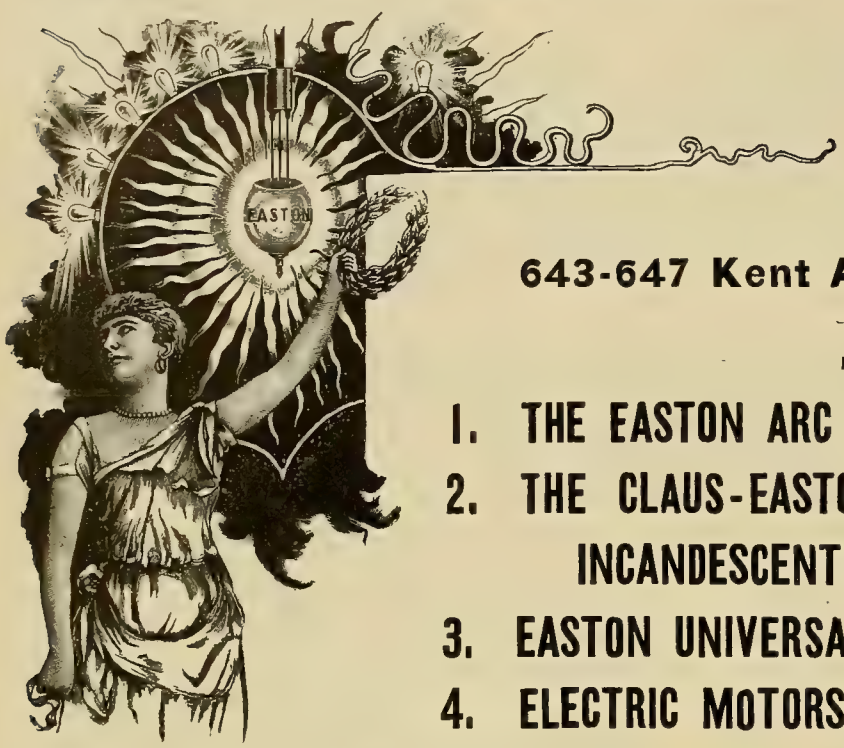

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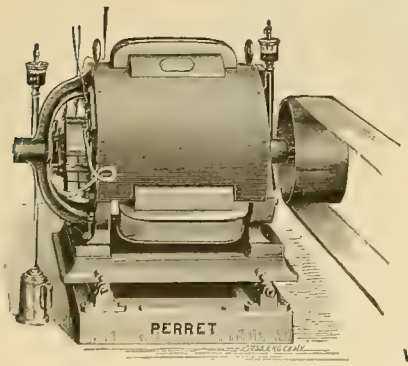

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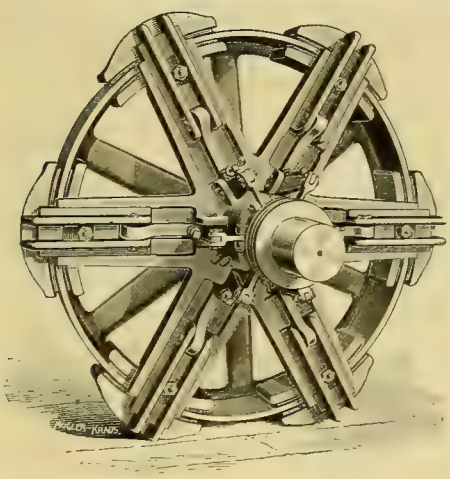

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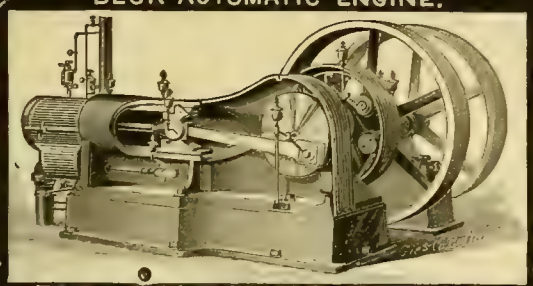

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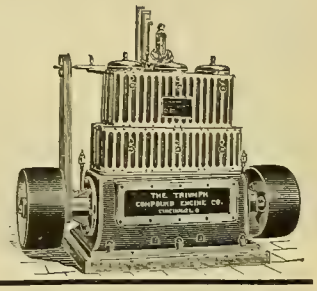

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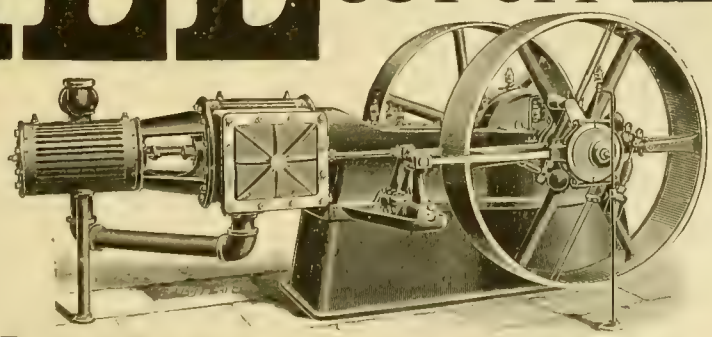

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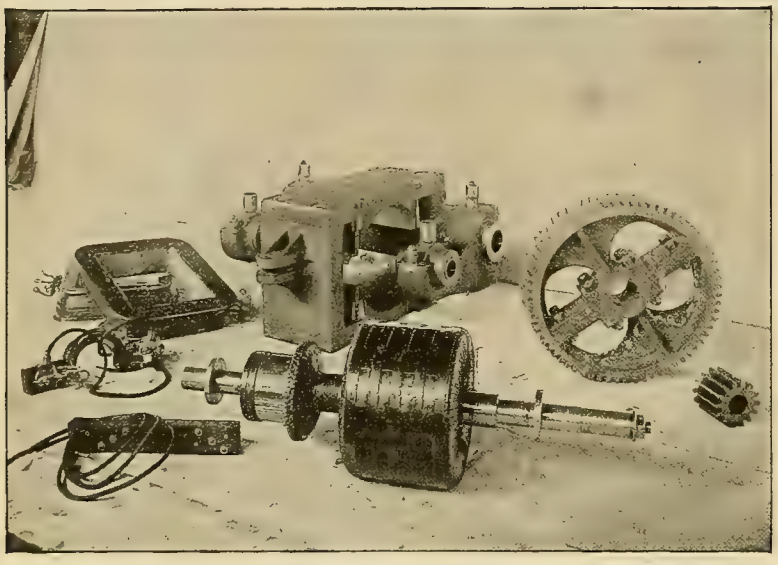

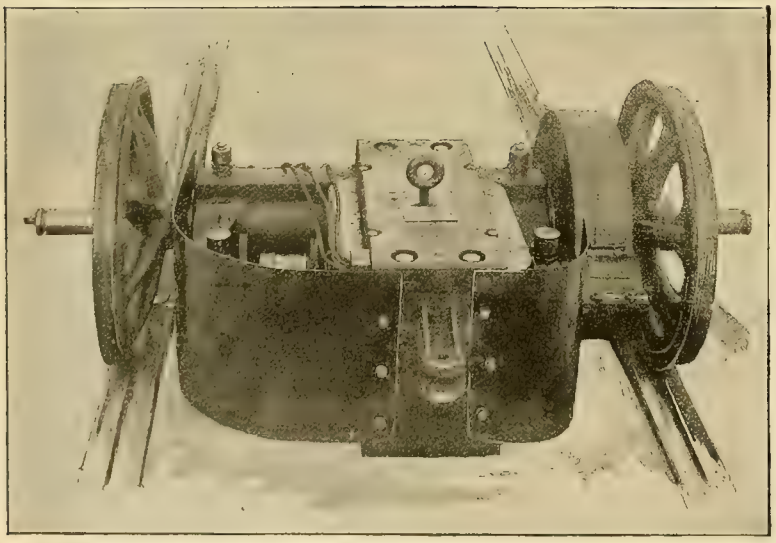

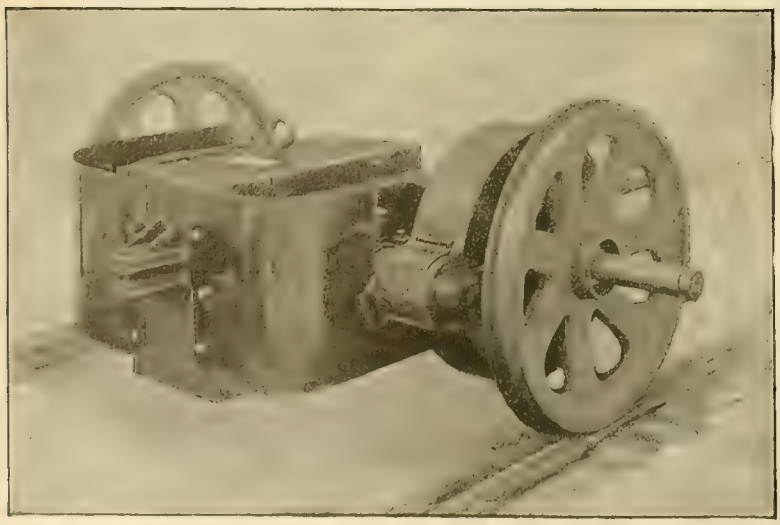

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118 WEST WATER STREET.

Piqua, Ohio. Dec. 9 1890

Elec. Supply Co.
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Yours truly,
Piqua Electric Light and Power Co.
By H. C. Brooks, Supt.

W. R. Dawn, President. J. V. Garner, Vice-President. Geo. S. Dawn, Sec'y & Treas.

Ottumwa Railway, Electric & Steam Co.

105 South Market Street

Ottumwa, Iowa, Dec. 9th 1890

The Electrical Supply Co.
Gentlemen

Yours of 8th inst at hand also yours of 2d was duly rec'd. It was entirely unnecessary for you to call our attention to the strong points of the Shield brand wire as we have put up over 30 miles of Electric Light lines this season using your Shield brand wire throughout and we are satisfied that we made no mistake in selecting your wire for this work. We are not in need of any line wire at present.

Respectfully
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By W. R. Dawn Pres't
Ottumwa Electric Light Co.
By W. R. Dawn Manager

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All other devices are crude, expensive, and unsatisfactory.

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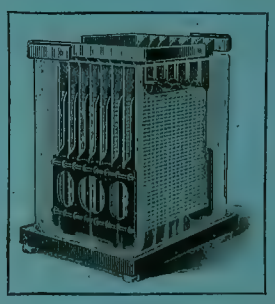

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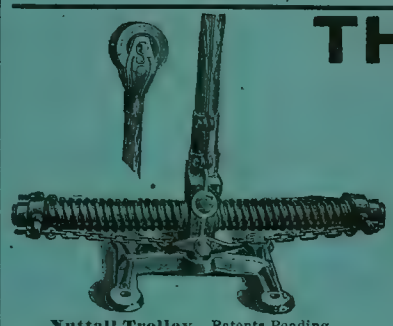

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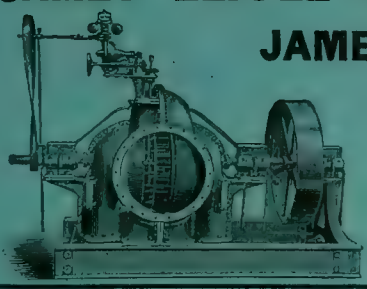

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The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

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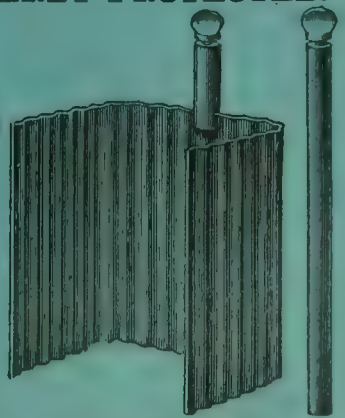

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1,450	MISSISSIPPI,	1,200
9,750	KENTUCKY,	3,300
81,550	TOTAL,	67,060

Over 14,000 more of the Thomson-Houston System than

ALL OTHERS COMBINED.

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Edison General Electric Co.
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Great Western Electric Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Illinois Electric Material Co.
Knapp Electrical Works.
Monitor Electric Co.
Roebling's Sons Co., Jno. A.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

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Central Electric Co.
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Monitor Electric Co.
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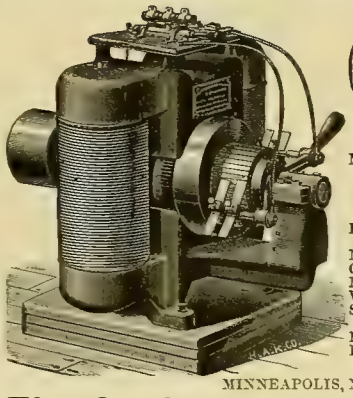

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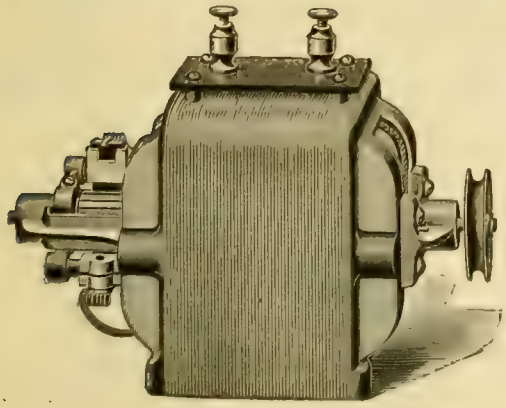

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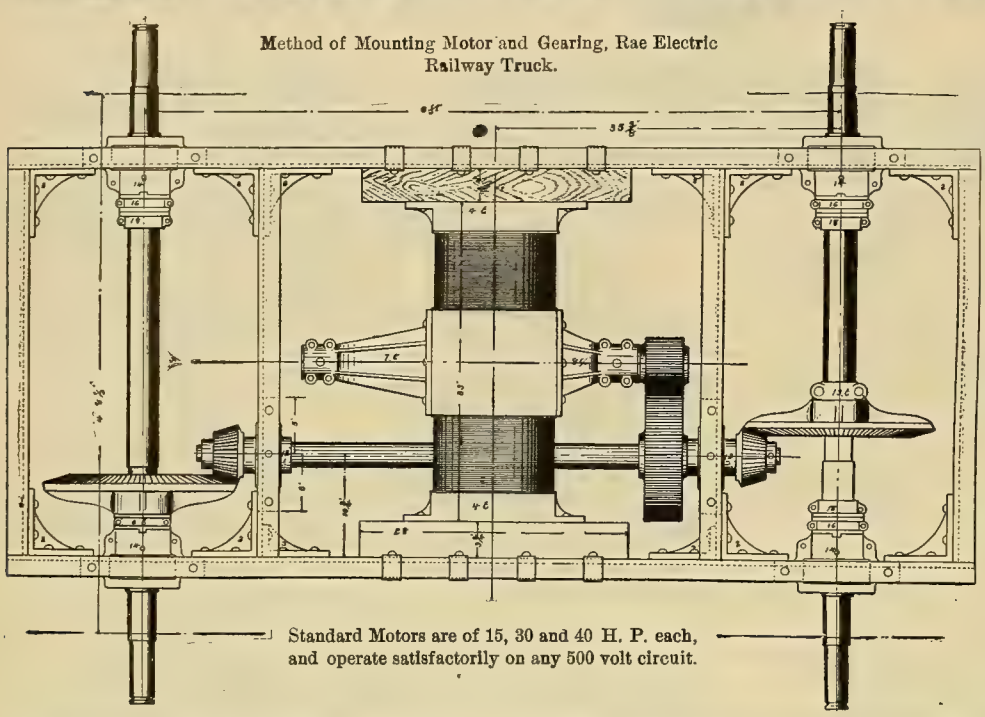

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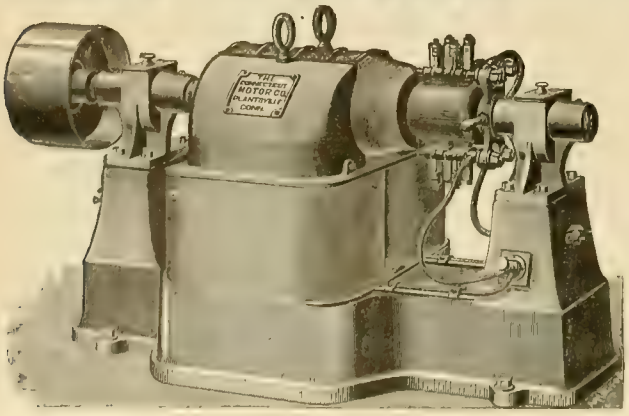

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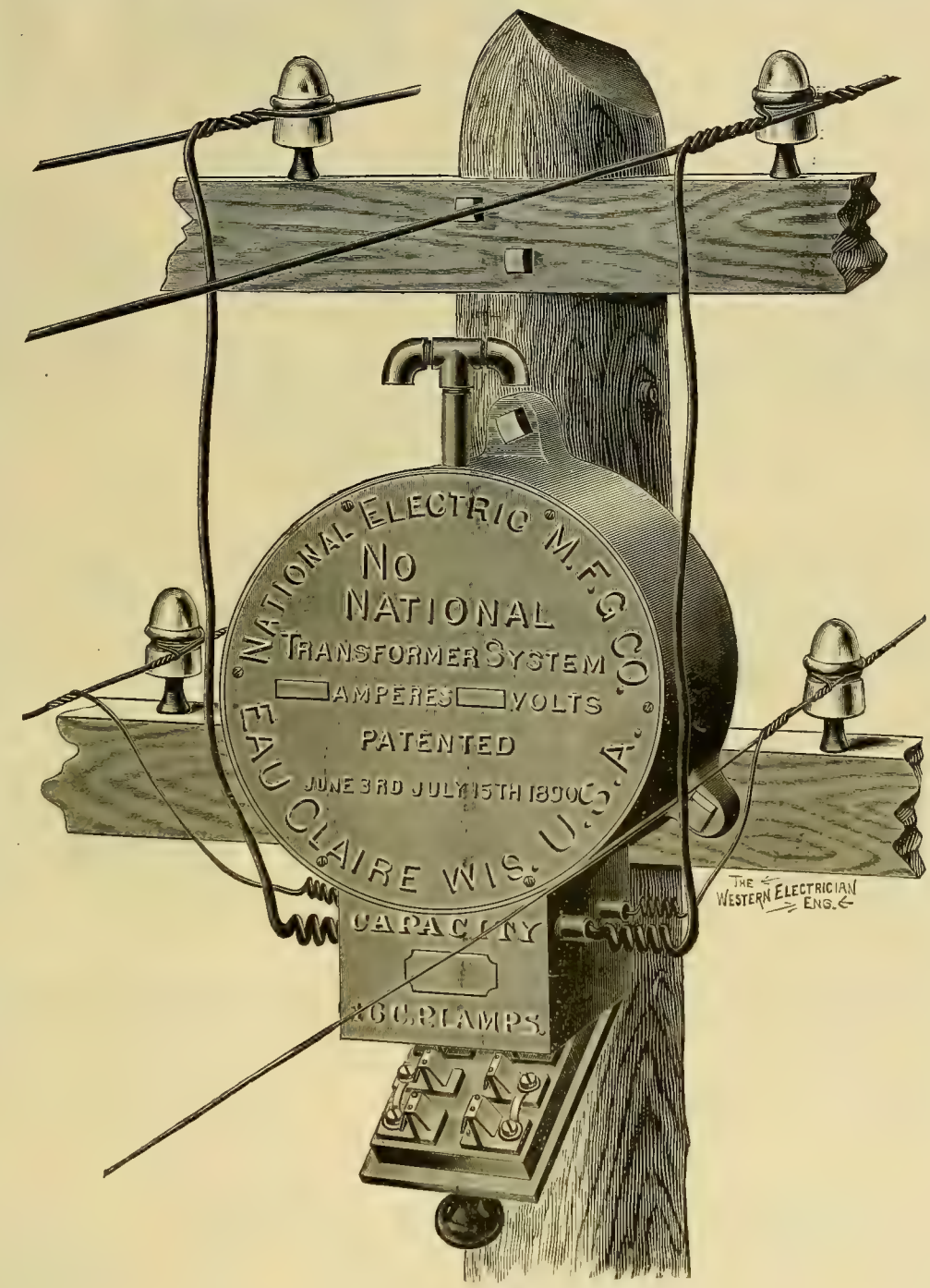

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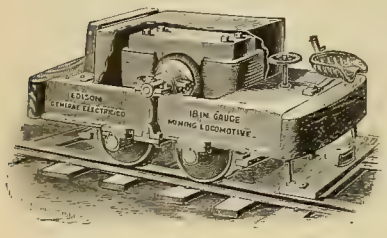

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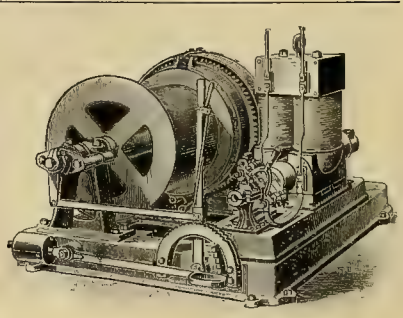
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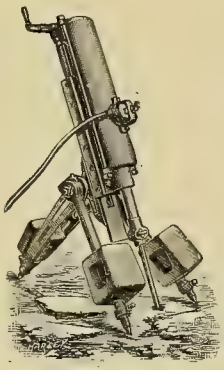
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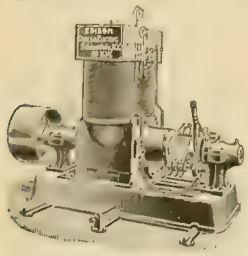
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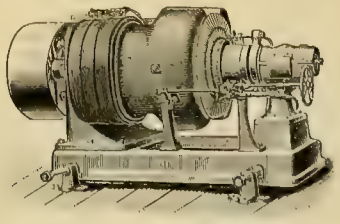
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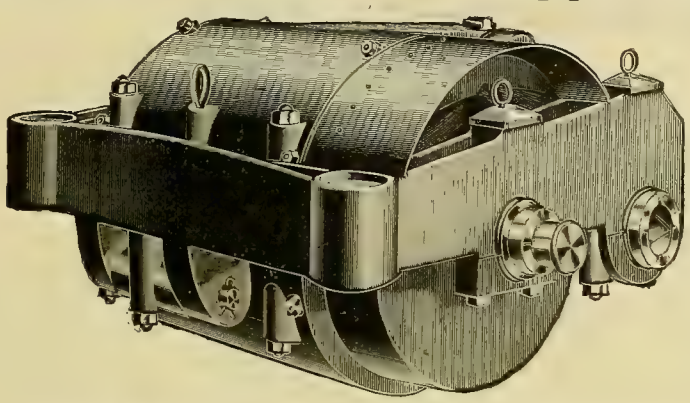
The shape of this iron should be CYLINDRICAL, like the turret of an "Ironclad."

Armature bearings should be DUST-PROOF. Moving parts readily ACCESSIBLE.



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A motor with fields and armature SHELTERED above, SHIELDED below, ENCLOSED on the sides, DUST-PROOF and ACCESSIBLE. Small air gap and loss of very few lines of force, the resultant of which is very high efficiency, over 90 per cent.

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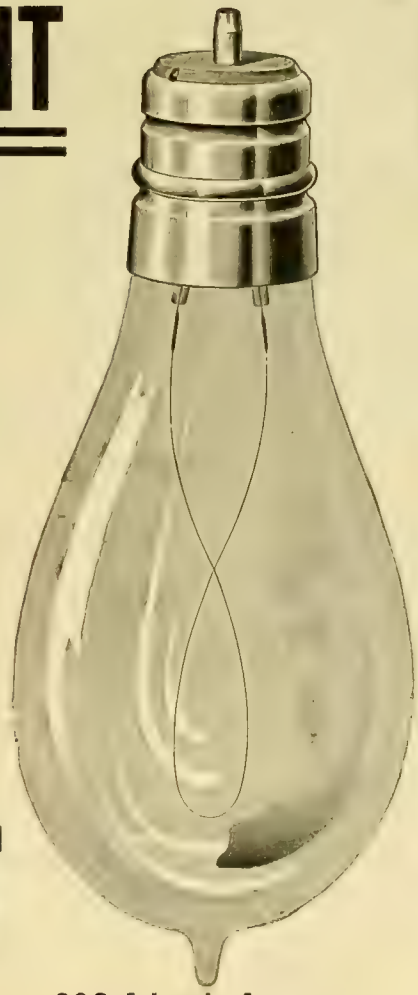

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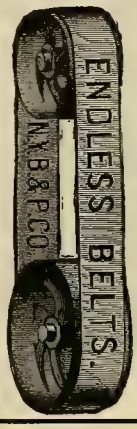

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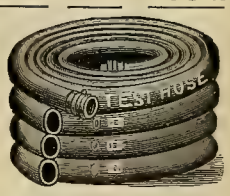
Particularly adapted for Dynamo uses; made of any width or length to order, at a week's notice.



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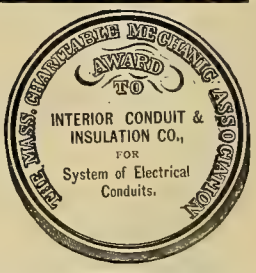

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Burns singly or in series.
One Lamp of Standard Candle Power uses 4 to 5, and two in series 8 to 10 amperes.
The ARC can be SHORTENED or LENGTHENED IN HALF A MINUTE.
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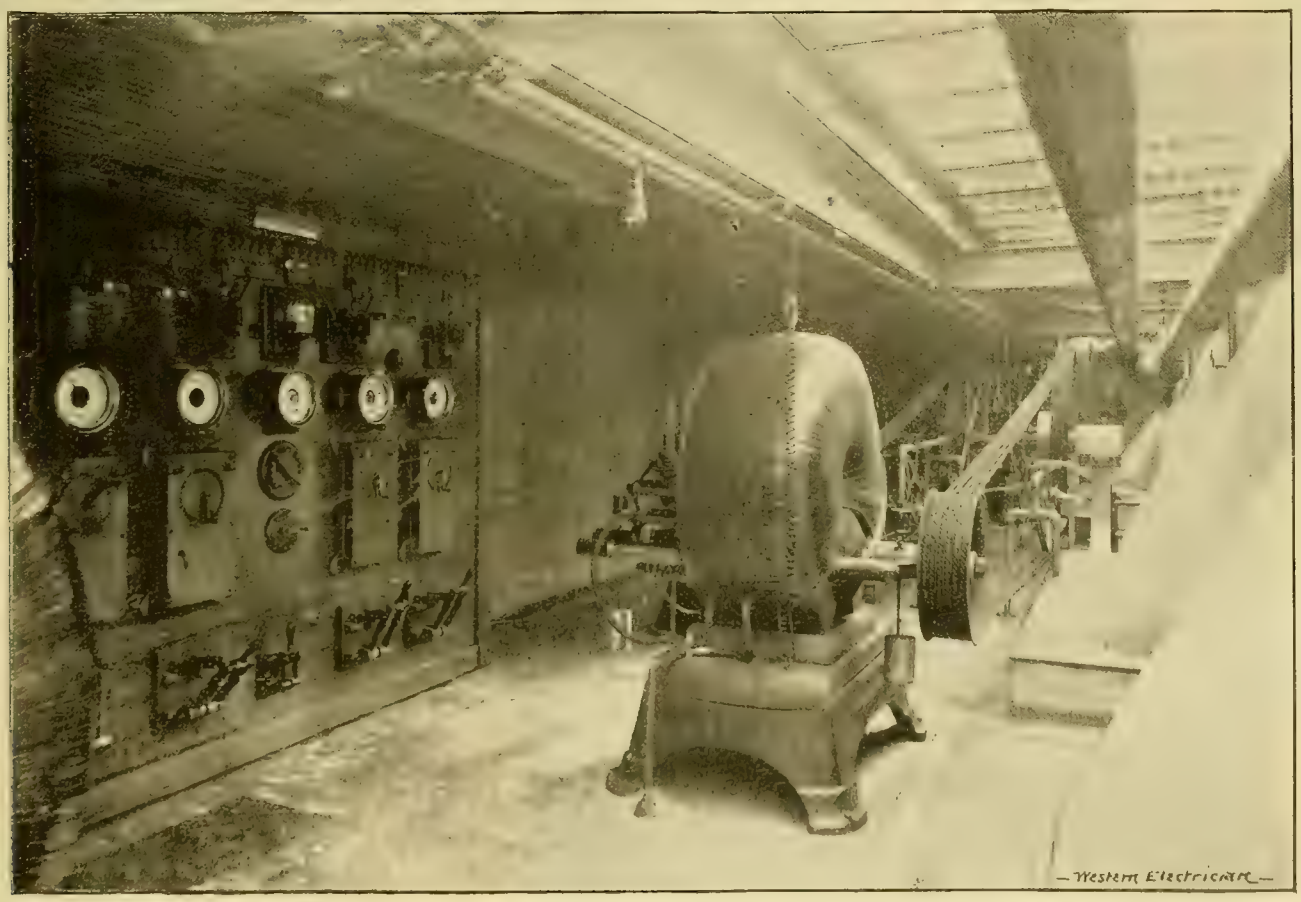
EVERY SATURDAY.

Vol. VIII. CHICAGO, APRIL 4, 1891. No 14

Chamber of Commerce Plant, Chicago.

One of the most striking buildings in Chicago and one that attracts the attention of visitors to the western metropolis is the Chamber of Commerce on Washington and LaSalle streets. This handsome structure is thirteen stories high. When the lights are turned on in the evening to illuminate the interior court it presents a magnificent spectacle. These lights are arranged in clusters of seven all around the court on each floor and only 16 feet apart. There are 3,400 lights distributed about the building. These are supplied with current from four Mather dynamos, operated with two 150-horse power Corliss engines.

The plant is located in the basement of the building, and a view of one-half of the dynamo room is shown in the accompanying illustration. The space available was so limited that the arrangement of the machines required considerable skill. The engine room is 113 feet long and 11½ feet wide. Two dynamos are driven by each of the engines, rope transmission being employed. The Link Belt Manufacturing company of Chicago supplied the rope. The engines were furnished by Weisel & Velter, Milwaukee, and the electrical equipment by the Mather Electric company. The plant was installed under the direction of the Chicago office.



CHAMBER OF COMMERCE PLANT, CHICAGO.

The Consumers' Electric Light company of New Orleans will hold a meeting on April 11th to consider the increase of its capital stock from $40,000 to $150,000.

Municipal Lighting Plant.

The political campaign which is now occupying the attention of the people of Chicago brings up the question of municipal ownership of electric plants and other private interests. It served to illustrate, too, the force of the statements made in these columns, that an extensive city lighting plant, entailing the employment of a large force of men, would necessarily develop into a political machine. The present city administration has been working assiduously throughout its entire term to secure control of all public enterprises of this character. It desired, by increasing the number of dependent employes, to perpetuate its control of local affairs. Already it is endeavoring to make capital out of its record on the municipal lighting question. It claims that if returned to power it will pursue the same policy that it has followed during the last two years. It is earnestly to be hoped that it will be rebuked. If the Chicago politicians were vested with authority to assume control of the commercial lighting of the city, the people would find that the boasted economy of the principle of municipal ownership was not to be found in practice.

Chicago is not the only offender in this line, however. Baltimore and Richmond have the fever, and Massachusetts is, of course, the hotbed of the Bellamy craze. In Baltimore Mayor Davidson favors the municipal ownership and control of an electric lighting plant, and urges the feasibility of the scheme upon grounds of economy and progress. In Richmond the city owns a gas plant, and Mayor Ellyson, in his recent message, declares his confidence in the utility of the plan. He urges the reduction of the price of gas, and states that the success attending the gas experiment warrants the immediate establishment of an electrical lighting plant by the city. In Massachusetts this question was made a subject of special investigation by the legislative committee on manufacturing. A vast amount of testimony was taken, and it was finally decided to report that an enabling act ought to be passed empowering every municipality in the state to acquire or establish its own gas and electric plants at the pleasure of its citizens.

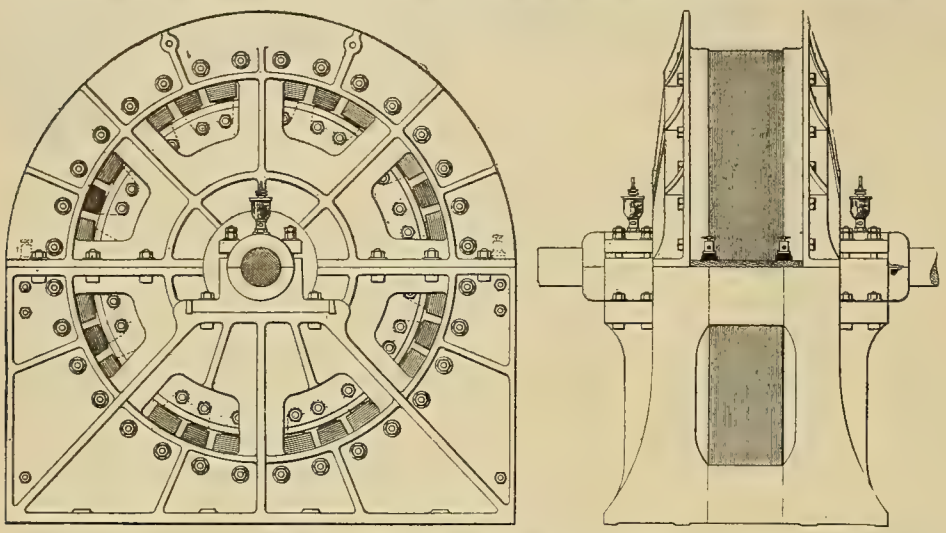
Regulating Telegraph Tolls.

The Michigan legislature has been considering the question of telegraph tolls for some time. Several bills have been introduced in both houses and have been referred to committees. A dispatch from Lansing, Mich., says: "After a hard fight against it by the Western Union company the house committee on state affairs has decided to favorably report a bill reducing telegraph rates in Michigan from 25 to 20 cents for ten-word messages, and from 2 cents to 1 cent for each subsequent word."

The Monterey, Cal., Electric Light and Development company has closed a contract with the Edison company for a central station plant, to supply Monterey and Pacific Grove with lights. A 540 light incandescent plant is to be n operation in forty-five days.

Kingdon Inductor Dynamo.

In the accompanying illustration is shown an alternating current dynamo, designed by J. A. Kingdon, London, Eng. In this machine, Figs. 1 and 2, the coils, which correspond both to the armature coils and to the field magnet coils of an ordinary alternating current dynamo, are fixed, while the revolving wheel carries a number of laminated masses of iron or inductors, which produce by their motion magnetic changes in the iron cores of the armature or secondary coils. The magnets of the dynamo are built up of a number of stamped iron plates, each plate being of the shape shown in Fig. 3, and having four projecting core pieces. These plates are bolted between two stout cast-iron frames, which also carry the pedestals. The machine is divided horizontally across the center line so that the top can be lifted off and the wheel taken out. There are thirty-two magnet cores projecting from the magnet ring, and sixteen of these are fitted with the primary or exciting coils, and sixteen with the secondary coils in which the alternating current is generated, primary and secondary coils being placed alternately. In the diagram the poles marked *N S N S* are primary poles, and are magnetized by means of an exciter with the polarities indicated. The intermediate poles *n s n s* are the secondary poles, and have their magnetism constantly changed as the inductor wheel rotates. The number of inductors, which consist of a number of stamped iron plates bolted between two steel disks carried on a hub on the shaft, is sixteen, half the number of the magnet cores.



FIGS. 1 AND 2. KINGDON INDUCTOR DYNAMO.

The action of the machine is as follows: In the position of the wheel shown in Fig. 1 the secondary poles have the polarities indicated, magnet on the other side. The inductor wheel thus acts as a magnetic commutator, and as it rotates continually changes the polarities of the secondary magnets. Alternating currents are accordingly generated in the coils wound on the secondary magnets. The polarity of the secondary magnets being changed thirty-two times during each complete revolution, the number of alternations per revolution is thirty-two, being equal to twice the number of the inductors, and being quite independent of the number of primary or secondary coils.

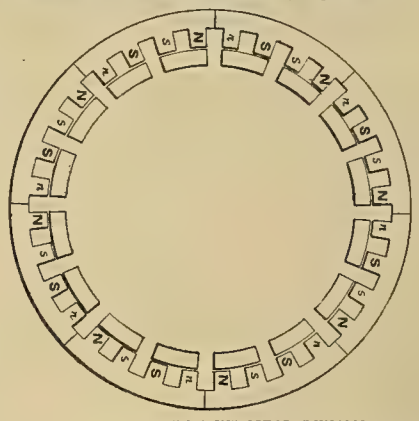
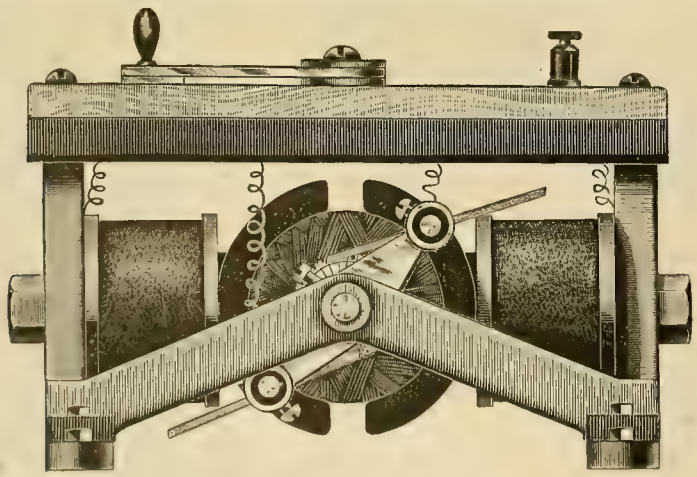


FIG. 3. KINGDON INDUCTOR DYNAMO.

Hay Electric Motor.

Walter Hay of Chicago has devised an electric motor, which is shown in the accompanying illustration. It is to be made in sizes ranging from one-twelfth to one-half horse power, and is manufactured to supply the demand for small motors of high efficiency. The frame is cast from a special quality of soft iron. The armature is of new design, and, in motors of one-fourth horse power, it is encased at the ends. This construction adds much to the appearance of the machine, and prevents injury to the winding. The fields and cores are of the softest annealed iron, firmly bolted to the frame. Long bearings support the steel shaft, and the brushes are held against the commutator by springs of peculiar shape.



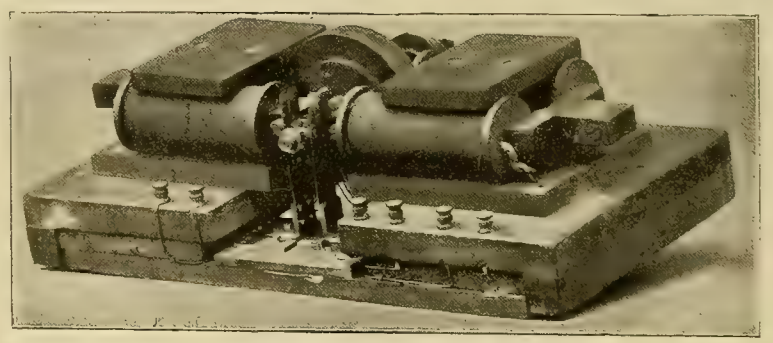
HAY ELECTRIC MOTOR.

Chicago Electric Club.

The next regular meeting of the Chicago Electric club will be held at the rooms, 103 Adams street, Monday evening, April 6th, at 8 o'clock. The paper of the evening will be on "Regulation of Constant Current Generators," by Alex. Dow. The committee on new quarters will present its report at this meeting.

Varley's Original Dynamo.

J. P. Barrett, chief of construction of the department of electricity of the World's Columbian Exposition, has received a communication from S. Alfred Varley of England, in which that gentleman expresses a willingness to come to this country and exhibit his "original self-exciting dynamo" at the World's Fair. The electrical department has the proposition under advisement. The accompanying cut illustrating the machine is reproduced from a photograph furnished by Mr. Varley.



VARLEY'S ORIGINAL DYNAMO.

Electric Railways for Express and Mail.

The advantages of the electric railway for mail and express service are beginning to force themselves upon the officials of the express companies and the government. Already this service has been established in a western town so far as the express is concerned, and the people of St. Louis want the electric roads to get the mail service. A bill has been passed by the state legislature providing for an extension of the powers of street railway companies so that they may make contracts for carrying mail. At present in all large cities cumbersome wagons are employed to carry the mail from one district to another, and much time is lost. Moreover, the proposed system would effect a radical saving. A gentleman interested in the subject said: "The matter," said he, "has been brought to the attention of the postoffice authorities on various occasions, but I do not know the origin of the bill. Kansas City is interested in it as well as St. Louis, and I suppose that other cities are, as well. The manner in which we propose to use the street cars here is similar to the plan that has been in vogue on the steam railroads for years."

Electric Lighting at McVicker's Theater, Chicago.

The opening of McVicker's new theater, Chicago, last Monday evening, was the event of the season in society and theatrical circles. The house is handsomely finished and brilliantly illuminated by incandescent lamps. Special attention had been given the details of the electric plant, and the equipment is considered the most complete that has thus far been installed in any theater in Chicago. Before the formal opening of the house there was a test made in the presence of the architect and a number of managers of Chicago theaters. The trial proved thoroughly satisfactory, and was especially interesting to those engaged in theatrical work as it showed the superiority of the electric light for securing stage effects. In the accompanying illustrations are shown the stage switch-board and the dynamo switch-board.

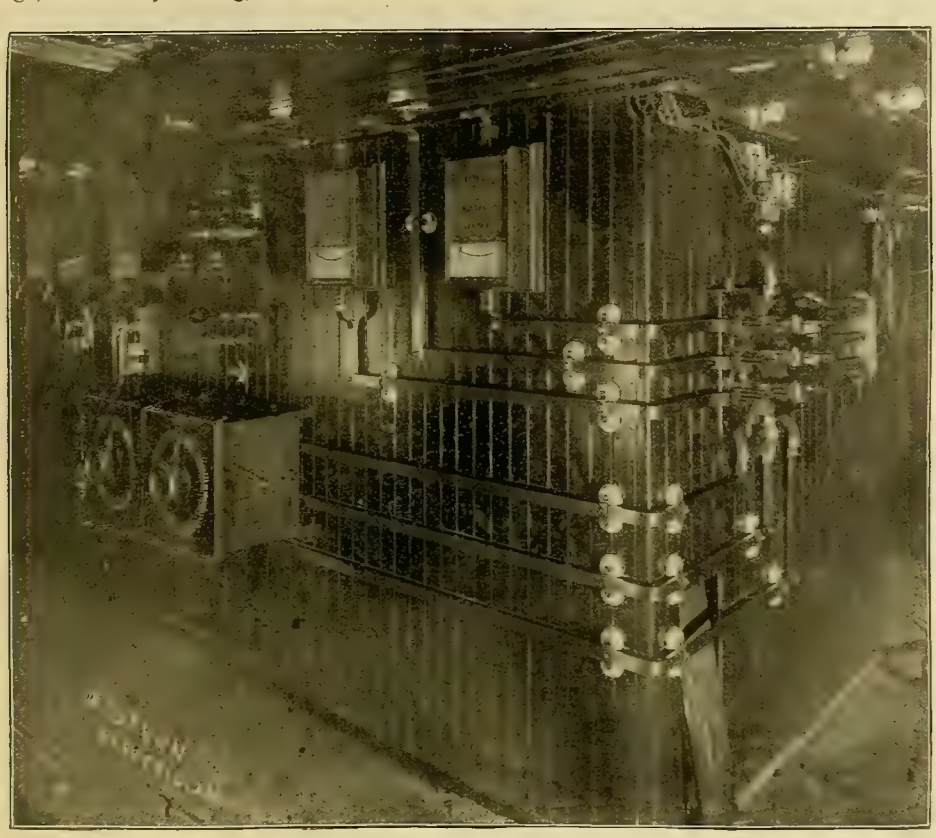


FIG. 2. ELECTRIC LIGHTING AT M'VICKER'S THEATER, CHICAGO.

In the distribution of lights special care was taken to secure brilliant effects without dazzling the eye. The main ceiling is lighted by five light clusters in the center of each of 15 panels, attached by means of special oxidized copper fixtures to the bottom of a perforated plaster pendant. The lights in the balcony and gallery rails are arranged in clusters of four, making 100 lights in each rail. The lights in the coves under the balcony and gallery are single lights projecting from the center of the decorations.

In the main foyer are two beautiful statues in Grecian attire of oxidized copper finish and holding upright a spray of 15 lamps with variegated colored shades. Throughout the entire plant there are connected an equivalent of 2,100 16 candle power lamps, 1,100 of which are upon the stage, 530 in the auditorium of the theater and 450 in the office building, basement and adjoining rooms. The lights in the auditorium with the exception of 30 safety brackets are wired upon the ordinary three wire system. All stage lights which are controlled by resistance boxes—viz.: the footlights, borders, bunch lights, ground rows, strips, etc.—are wired upon a 228 volt multiple series system.

The day circuit, which comprises the lights in the theater and office building not subject to tone, are wired upon a three wire convertible system. The generating apparatus is the same as was formerly used for lighting the old theater and consists of two No. 20 Edison dynamos driven by an Armington & Sims engine and one No. 4 Edison dynamo driven by an Armington & Sims engine. The armatures of these dynamos were soaked in water for thirty-six hours during the fire but were afterward baked out and each tested with a load of 350 amperes at 117 volts for several hours. Instead of piping the theater for gas to be used in case of a break-down of the dynamos or engines, a three wire feeder was run from the Chicago Edison company's underground mains on Madison street to the dynamo switch-board. At the switch-board this feeder connects to one side of a triple throw-over switch of 500 ampere capacity. To the opposite side of this switch are connected auxiliary bus bars into which the two No. 20 dynamos feed.

The main bus bars lead from the center points of this switch, so that when the blades of the switch are in contact with one set of clips the theater is lighted from the isolated plant and when thrown in contact with the opposite set of clips the theater is lighted from the central station mains. This change from isolated to central station lighting is effected by simply throwing this switch, which takes less than two seconds, and with this arrangement it is utterly impossible to feed the central station current into the isolated dynamos, or vice versa. At the left of the board is another smaller triple throw-over switch of 25 ampere capacity, which is so arranged that the day circuit may be lighted either from the No. 4 Edison dynamo, the central station or the No. 20 dynamos. The mere throwing of the switch from one side to the other changes the day circuit instantaneously from a two to a three wire system, or vice versa. All the wiring between the dynamos and the switch-board is bare copper in polished rectangular section bar and is supported by polished cleats of special design, which insulate the copper from the woodwork.

The resistance boxes, nineteen in number, for toning the lights in the theater, are located in two rooms especially designed for them, with walls of fire-proof tile and brick in the basement directly under the stage switch-board. These resistance boxes are of the latest type of fire-proof regulator built in iron frames and each containing fifty-four separate coils.

The stage switch-board is situated at the right of the proscenium opening and is built on an angle of about 30 degrees, and is eight feet in length. At the bottom of the switch-board are placed the regulator switches, which are mounted on slate bases 31x17 inches. These switches are of special design, having fifty four segments so arranged and connected as to give a perfect

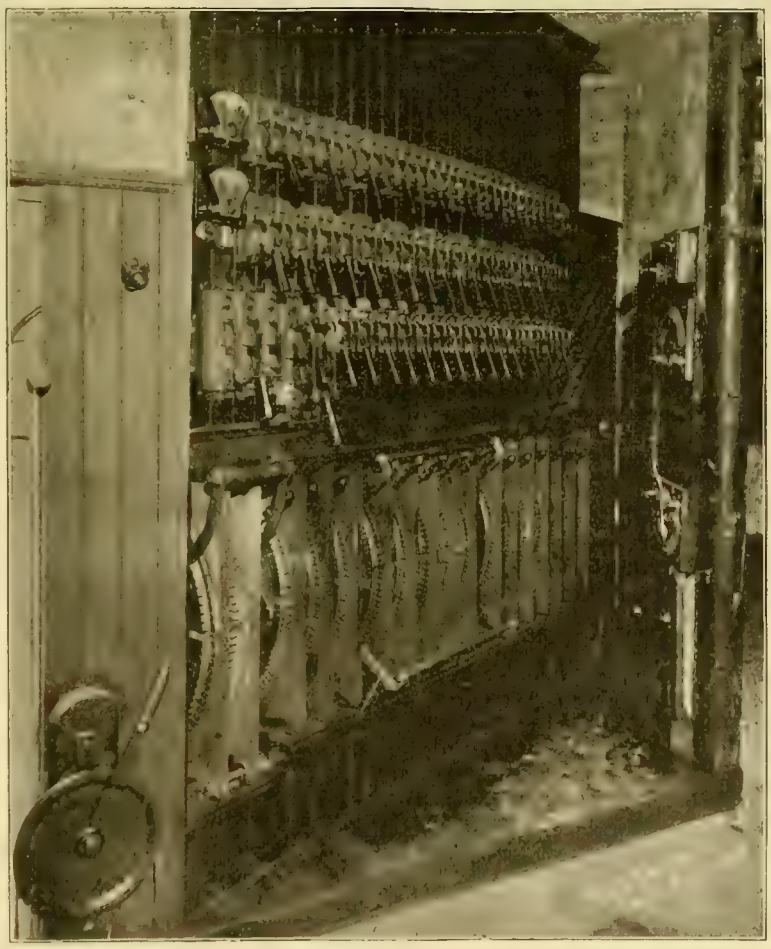


FIG. 1. ELECTRIC LIGHTING AT M'VICKER'S THEATER, CHICAGO.

graduation of the light from full candle power to an almost imperceptible glow.

Above the regulator switches are placed the circuit switches, 12 triple pole 50 ampere, 1 triple pole 125 ampere, 30 double pole 50 ampere, 1 double pole 250 ampere, making a total of forty-four switches. These switches are of the knife type of special design and are mounted upon slate bases. Although the number of switches may appear large, the operator will not be called upon to use them all during the progress of the play, and the arrangement is such as to especially facilitate the working of the lights. The upper row of switches controls the different circuits in the auditorium, but they are never opened during the play. The second row controls the footlights and borders, each of the three colors in the footlights and borders having a separate switch.

The two large switches in the lower row control respectively the entire auditorium and the entire stage, so that if an instantaneous dark theater is wanted, it is obtained by drawing these two switches. The next four switches in the lowest row are main switches for the colored borders. The remaining switches control the bunch lights, ground rows, strips, flies, stage chandelier and painters' bridge. Each knife switch on the stage switch-board opens all poles of its respective circuit, and is so placed in the circuit as to cut out the resistance box.

The large regulator switch at the left hand side controls the entire auditorium, the next three the white, red, and green footlights respectively. The regulator switches for the five white borders come next, so arranged that they may be operated independently or together. The next four switches control the two red, two green, three red, three green borders in the order named. The remaining three switches control the bunch lights, ground rows and strips.

The two small regulator switches seen at the side control two special circuits for burning one bunch light or one ground row. The double point switch above is used for changing the pressure on the bunch light circuit from 228 to 114 volts to accommodate special scenery wired for the ordinary two wire system. The white footlights are placed in one row nearest the audience, and are stationary.

The red and green footlights are in one row in front of the white footlights. They are attached by means of brackets to an iron pipe through which runs the main wire feeding them. To avoid the absorption of the white lights by the colored lamps when not in use the latter may be lowered to a horizontal position by means of a mechanism of bevel gears, cable and pulleys controlled by a handle at the stage switch-board.

The border light reflectors are built in two compartments, the upper containing the colored lamps and the lower compartment the white lamps. There is a proscenium strip containing fifteen lamps on either side of the proscenium opening, also four entrance strips, each containing fifteen lamps. There are ten bunch lights, six of six lights each, and four for one 100-candle power lamp each, also six ground rows of six lights each, together with numerous other special apparatus for the stage.

Especial attention was given to the plan of wiring arrangements, minimum variation of pressure, centering of safety devices, ease of operating stage apparatus, and securing the best results in scenic effects.

The plant was installed by the Chicago Edison company. The entire installation was designed and engineered by Louis A. Ferguson, electrical engineer of the Chicago Edison company. The work was done by George Owens under the personal direction of J. H. Goehst.

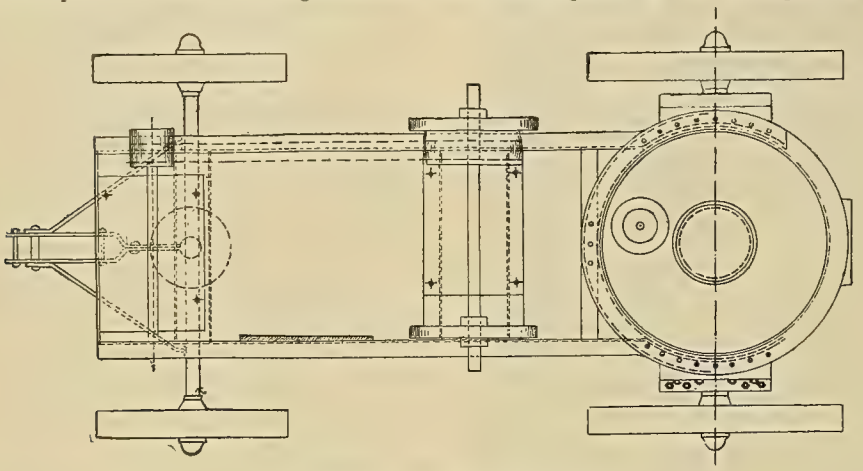


FIG. 2. PORTABLE ELECTRIC LIGHT OUTFIT.

Portable Electric Light Outfit.

In the accompanying illustrations a portable electric light plant is shown. It was designed and constructed at the Newmarket Electric company's factory at Nurnberg, Germany, for the use of societies and clubs and at public festivals, where a permanent plant would be out of the question.

The construction of the outfit is readily seen by referring to the cuts. A heavy truck carries a upright boiler, a small high speed Westinghouse engine, whose capacity is 12 horse-power, and a Schukert flat-ring dynamo giving 8 amperes at 300 volts pressure. The engine and dynamo are protected from the weather by a caboose, the ceiling of which is provided with means for carrying six arc lamps, of 1,200 candle power each. Along the sides of the caboose, neatly stored away in sideboards and on shelves, is a complete outfit of wires, insulators, reflectors, lamp carbons and all the necessary tools for building and maintaining a short temporary line. There is a great demand for the plant, and it is expected it will prove quite profitable, especially in connection with public and private entertainments, which are so numerous. The cuts are reproduced from *Electrotechnische Anzeiger*.

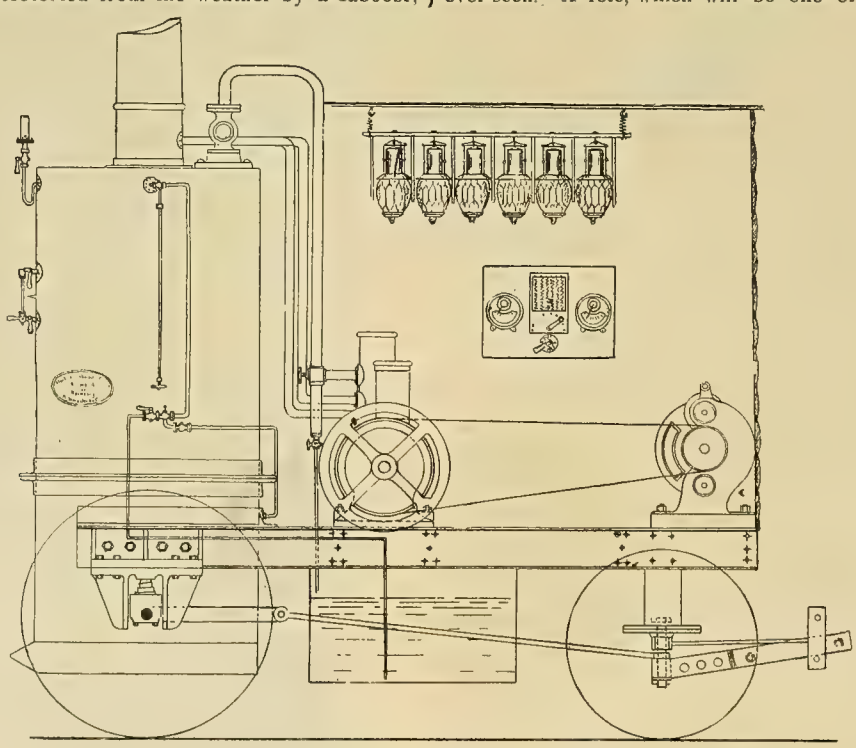
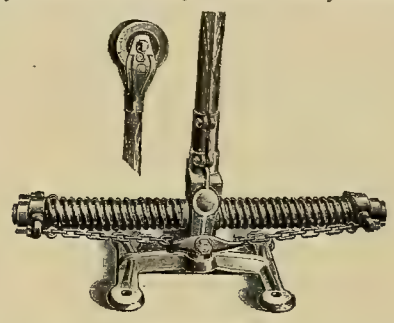


FIG. 1. PORTABLE ELECTRIC LIGHT OUTFIT.

Nuttall Trolley.

The accompanying cut illustrates a new trolley arm, adapted to all systems, and placed on the market by the Electric Railway Specialty company of New York city. This trolley is unusually light. The arm is made of wood. The device is simple and the compression spring is practically indestructible.



NUTTALL TROLLEY.

The Montreal Convention.

Much interest is manifested in the coming mid-summer convention and exhibition of the National Electric Light association by the press and public of Montreal. Sir William. Dawson, principal of McGill university, has placed the college museum and library at the disposal of the delegates while they are in the city. The *Montreal Herald*, in speaking of the convention, says: "A. J. Corriveau has received a communication from Quebec and Levis stating that those places will be glad to entertain the delegates attending the National Electrical convention in August next. They are anxious to show their 34 mile water power electric circuit, which is one of the longest in America. Several large electrical firms in the states have applied for space in the electrical exhibition, which will be open for a week and will be one of the finest ever seen. A fete, which will be one of the most novel things ever seen in America, is to be arranged for the close of the convention. Prof. Bovey is taking considerable interest in the event and is preparing an interesting exhibit. Canadians should take a great deal of interest in the convention, says Mr. Corriveau." Steps are being taken to form a citizens' reception committee.

Utilizing Water Power for Electric Plants.

The question of utilizing the water power of the Niagara has directed general attention to the subject of transmission of power by electricity and the discussion has brought to light many facts which will be of great significance in the commercial world. In the accompanying illustration is shown a view of the Bassaseachic falls, which heretofore have never been utilized, but which modern methods have made available. This cataract is in the neighborhood of the mining town of Jesus Maria, in the state of Chihuahua, Mexico, and but for its remoteness from any of the beaten paths of tourists, must long since have become widely celebrated. It is a part of the property of the Santa Juliana Mining company.

These falls are 1,000 feet high and are said to have the highest perpendicular drop of any waterfall in the world. If there is any exception it is the first leap of the famous Yosemite falls in California. The stream of which Bassaseachic falls is a part is not a large one, but the body of water is sufficient to furnish an abundant water power, and this power it is now proposed to utilize, the design being to convey it by electricity to the town of Jesus Maria, some eight miles distant, where the mine is situated. Thus made available, it is estimated that the water power will be sufficient not only for the proprietary mine, but for all the mines in the neighborhood.

In the proposed utilization of the power of these falls, by converting and transmitting it in the form of electric energy to a point many miles distant, and there reconverting it into available mechanical energy, a remarkable example is given of the revolution in industrial methods. This cataract, with its ample store of power only waiting to be made effective, has been wasting not only its beauty but its vast utility in the seclusion of a Mexican wilderness for centuries.

UTILIZING WATER POWER FOR ELECTRIC PLANT.

Progress of Ferranti's Work at Deptford, England.

The following is the substance of a report made March 3d by S. Z. De Ferranti to the directors of the London Electric Supply corporation, limited:

Since I reported to you a year ago the engineering work of the corporation has gone through a period of considerable activity under my direction. The concentric mains which you have manufactured under my patents have proved to be a complete success. Four concentric trunk mains have now been laid from Deptford to London, consisting in all of some 25 miles. They are laid in 20-foot lengths, and thus in the above distance there are no less than 6,500 joints. The work of laying was of necessity performed by unskilled laborers who had neither experience nor training in such work, and I am glad to say that on first testing the mains only some 20 joints out of the entire number proved to be defective. These defective joints are easily found and rapidly replaced. The mains have been thoroughly tested with a pressure of 17,000 volts, and have stood this test perfectly, and as you are aware they are now in daily use at a pressure of 10,000 volts, the normal pressure of your permanent work. With the sanction of the Board of Trade earthing arrangements have been made in connection with the mains and other portions of your system, and the working is so satisfactory that no disturbance whatever is caused to the telephone or telegraph systems; in fact, neither the postoffice nor the telephone company are able to say when your machinery is working.

During the past year the whole of the machinery from the Grosvenor station has been removed to Deptford. The dynamos, which were designed to give 10,000 lights each, have been found capable of supplying with ease 15,000 lights each; consequently, two larger engines for working these machines to their full capacity have been erected at Deptford during the year. These dynamos have been put into a thoroughly efficient state, and with this plant the work is now being done. In addition, two larger engines, each of 1,500 horse-power, which had just been erected at the date of my last report, have been got into efficient running condition, and the necessary alterations are being made to the two larger dynamos (each capable of giving 30,000 lights) that will enable you to use them, now that your concentric mains are complete, at the full pressure of 10,000 volts (for which the machines were originally designed), instead of 5,000 volts, the pressure first used. These machines will be working at 10,000 volts' pressure within the next three months, and you will then be in a position to generate current for 90,000 lights. It is not, however, proposed to supply more than two-thirds of this number at the same time, in order that a reserve of power sufficient to meet the requirements of the Board of Trade may be always kept in hand.

With these two large machines supplying your circuits the first important stage of your undertaking will be completed.

Great progress has also been made toward the next stage, though this work has not been pressed in view of making more rapid progress with that of the first stage. Nevertheless, more than three-fourths of the work of the next pair of dynamos has already been done. They will each be capable of supplying 200,000 lights, but in the first instance it is intended to supply engine power to each dynamo for 100,000 lights only, and by the end of another year from the completion of what I have called the first stage of your work, I expect to be in a position to report the completion of the second stage. You will then be able to supply 290,000 lights, less a proper reserve. Sufficient mains are already laid between Deptford and London to transmit the current which you will then have to dispose of.

I desire to call attention to the fact that from the commencement of your operations to the present time, no engineering or electrical difficulties whatever have arisen which I have not been able to overcome, and at the present moment I know of no weak point in your system, and consider success to be now assured.

It is a matter of great regret that a fire in your temporary distributing station in November last has caused a loss of the revenue which would otherwise have been earned, and which, owing to the extraordinary severity and darkness of the winter, would have been more than usually profitable. I am glad to say that this fire was not due to any defect of principle in your system, and could not have happened had your permanent distributing station been erected; but, as you are aware, it was an impossibility to erect the permanent station, the premises being occupied by the machinery which was then in course of removal to Deptford. The fire has, however, in some sense been beneficial, as it has allowed the permanent work to be pushed forward to an extent which could not otherwise have been possible, progress having been much delayed by the necessity of keeping a running business going during a period of progressive changes in the permanent system. The loss occasioned by the fire was not serious, so far as destruction of apparatus was concerned, but was principally felt in decreased revenue returns. The suspension of supply enabled good progress to be made with the laying of distributing mains, there being at the present time some 18 miles laid and in use.

It was important that this work should be pushed on, as the right to use overhead cables expires in the summer of this year, and the distributing mains being so well advanced, it has been deemed wise to discontinue the use of those cables. Your customers are now being connected to the permanent underground mains with the utmost possible speed.

A most important work has been completed during the past year in erecting at Deptford switching gear which allows all or any of the machines to be used separately or in combination. It has been further proved that the various machines can be worked together in parallel, a matter of considerable importance to successful working, as insuring the maximum of efficiency and economy.

The corporation has secured sites for three additional distributing stations, and the work of installing them with the necessary apparatus is being proceeded with. These stations will all be in work during the present year, each having two separate sources of supply at 10,000 volts pressure, which is lowered at these stations and distributed at 2,500 volts, being further reduced to 100 volts before entering the wires of the customer, as in the case of the low-pressure system.

At the time of my last report there were many parts of the system which were generally considered doubtful and more or less experimental. I refer more especially to the supposed difficulties of transmitting current from Deptford to London. The fact that current of 10,000 volts pressure is transmitted every day to London is the most complete answer to such doubts.

Effect of Electro-magnetism on Watches.

A Washington *Star* reporter has been interviewing a watchmaker of that city in relation to the effect of electo-magnetism on watches. He was told that imagination was the principal factor in the case of electric railways. "There is not one watch in a a million," said the watchmaker, "that is affected by the current on an electric street car line. Of course there are plenty of cases where watches have been magnetized by dynamos and other electric machines, but I do not believe that the current of a street-car line can possibly affect a watch. Some watches you cannot affect at all by electricity, while others go to pieces, as it were, as soon as they are brought within ten feet of a dynamo."

A bill has been introduced in the West Virginia legislature to allow the city of Parkersburg to generate, distribute, use and sell electricity.

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PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

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W. A. KREIDLER, - - - - - - - Editor and Publisher.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
W. E. KEILY, - - - - - - - - - - Associate Editors.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.

W. H. TEMPLE, Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE announcement in the leading editorial of the WESTERN ELECTRICIAN last week regarding the plans of the proposed electrical building at the World's Fair proves to have been correct in every particular. Inquiry at the headquarters of the construction department of the exposition elicited the information that the plans as described had not only been ordered completed, but that the allotment of space for the electrical building had been approved by the Board of Directors and the National Commission. In order to secure official information upon this subject the WESTERN ELECTRICIAN submitted to Chief Burnham a list of questions, presented in another column. Mr. Burnham while admitting the importance of the subject and promising to give it due consideration, declined to make a formal statement at present, but in conversation with a representative of the WESTERN ELECTRICIAN admitted that the statements made by this paper last week were correct in every detail. In an interview published in another column Chief Burnham admits that the dimensions of the proposed electrical building are only 750 by 350 feet, that it is proposed to place a large portion of the electrical exhibits including heavy machines in other buildings and that the display of electric railway apparatus will be assigned to the transportation building. These admissions fully justify the position assumed by this paper last week and furnish sufficient grounds for the emphatic protest made by the Chicago Electric club immediately following the publication of our editorial.

The announcement, moreover, proved the chief topic of conversation in electrical circles. It was unanimously agreed that a great mistake had been made and that immediate action was necessary. The WESTERN ELECTRICIAN has secured a number of interesting interviews with prominent representatives of electrical interests in Chicago, which are presented in another column. These statements clearly express the position of the electrical people generally.

An examination of the plans showing the arrangement of the buildings at Jackson Park as approved by the directors and commission reveals the fact that the electrical building as at present situated cannot be materially enlarged and that a change of location of this building would necesitate a complete rearrangement of the entire plans for the grounds and buildings as at present prepared. Moreover, such a change could only be made with the approval of both the directors and commissioners. It is certainly to be regretted that the arrangements for the Fair should have reached this stage before the discovery was made of the inadequacy of the provisions for the electrical department. Unless the plans are changed immediately and a rearrangement of the buildings secured, the electrical people will be obliged to content themselves with an exhibit that will be divided up among several buildings. Their hopes for a grand and imposing display of electrical apparatus of all kinds under one roof, showing the marvelous development of the industry, will have to be dismissed. It is admitted even by the Fair officials that the space provided in the electrical building is not sufficient to accommodate the electrical interests. Many exhibitors will be obliged to place their apparatus wherever they can get space in other departments. This is the outlook at present. Prompt action is demanded. It is true that Chief Burnham has promised to give the matter further attention, but the representatives of electrical interests can not rest with this assurance. They are anxiously awaiting some expression from Chief Barrett of the department of electricity to whom they will look to guard their interests and whom they will hold responsible should the electrical exhibit prove a failure in any particular. It should be mentioned in justice to Prof. Barrett that he has not yet recovered sufficiently to visit his office. When he does return to his duties, however, the electrical people expect him to record his protest against the present arrangement in no uncertain terms.

WITH possibly one exception, the WESTERN ELECTRICIAN was the only electrical paper that published a correct copy of Prof. Barrett's new classification of the electrical exhibits at the World's Fair. The others omitted entirely the class providing for exhibits of incandescent lighting systems—quite an important part of the display, as every one will admit. The young men who represent the Eastern papers should bear in mind the fact that the Chicago daily papers make gross blunders at times, especially when discussing electrical matters.

AFTER a perusal of Ferranti's last report on the Deptford system and also the account of the high tension experiments at the Oerlikon Works, Switzerland, one can but be impressed with the idea that foreign electricians are making most vigorous and promising efforts in high tension alternating current work. Ferranti gives a most encouraging account of his enterprise at London, and the Oerlikon experiments, with current at a pressure varying from 30,000 to 40,000 volts, serves to remind us that the art of insulation has yet to be learned. In connection with the Oerlikon tests the use of oil as an insulator should be noticed. The converters and overhead lines were both protected by oil with, it is stated, the most satisfactory results.

SOME curious statements relative to the deterioration of incandescent lamps are credited to Dr. Philip Atkinson of Chicago. According to an exchange, the "Chicago oracle" in a recent lecture asserted that "it would be economical to renew incandescent lamps at shorter intervals than the usual practice," and the reason for this was that "the resistance is reduced in the lamp the longer it is used, whereby the current is increased, while at the same time its luminosity is decreased." Instead of devising means to make the lamps last longer than they do, the problem most in need of solution is, according to the doctor, "how often a lamp should be renewed, in order to secure the best as well as the most economical results."

It is to be hoped that the doctor was not correctly reported.

S. Z. DEFERRANTI's last report on his work at Deptford, England, is presented in another column. According to this document the distribution of alternating currents with a primary pressure of 10,000 volts is now a demonstrated success. Four Ferranti concentric mains having a total length of about 25 miles, now connect the London system with Deptford station. These conductors have throughout their entire length as many as 6,500 joints, and it is stated, are in daily service under a pressure of 10,000 volts.

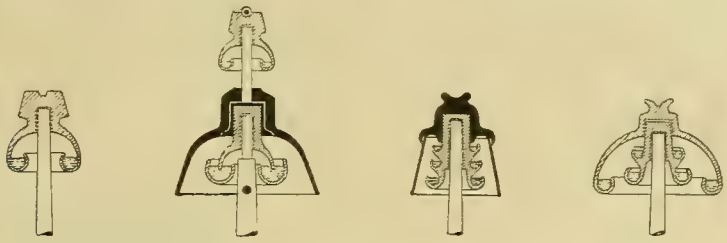
It is interesting in this connection to note the fact that our English contemporary, the London *Electrical Review*, to whom we are indebted for Mr. Ferranti's report, fails to question the success of the Deptford enterprise. The constant reader of the English electrical journals will remember that it was the London *Electrical Review* which all along predicted that a dismal failure could be the only result of Mr. Ferranti's labors. Can it be possible that Mr. Ferranti is succeeding after all? Or, is it possible that there is in preparation a last journalistic volley which will tell that the end has not yet come?

ACCORDING to the most recent New York dispatches that city is to have an underground railway system. The existing elevated roads will be granted permission to extend their lines and the New York Central & Hudson River railroad company will get a franchise to run its suburban lines as far as the Battery. This was brought about by Mayor Grant's rapid transit commission.

With this in view, it is now safe to say that New York will sometime have an electric railway. There may be opposition to the use of electricity as a motive power, but it can only come from or through the agency of rival systems. There will be many schemes proposed for propelling the trains. Steam locomotive men, the exploiters of compressed air systems of propulsion, the cable men—all will now prepare to push their respective projects, but with the great success of London's underground electric road before them, with its many advantages as now equipped, it is not to be supposed for an instant that the New Yorkers would consent to the employment of a motive power other than electricity.

Experiments with High Tension Currents at the Oerlikon Works, Switzerland.

C. L. Brown, manager of the Oerlikon Works, Switzerland, recently read a paper for the Electrotechnische Gesellschaft at Frankfort on the transmission of high tension currents. As this paper was based on extensive experiments made in the Oerlikon factory, and proved of considerable interest on the other side of the water, an account of the tests is given herewith for the benefit of American electricians.

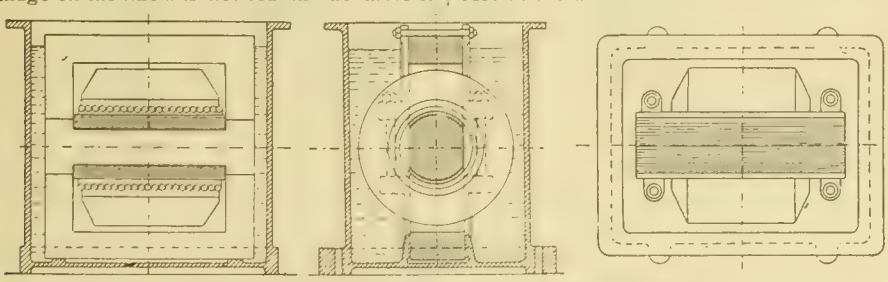


FIGS 2, 3, 4 AND 5. EXPERIMENTS WITH HIGH TENSION CURRENTS.

Fig. 1 is a diagram representing the experimental plant; *a* is an alternating current dynamo with a difference of potential of 130 volts, *b* is a fuse block for the protection of the dynamo, *c* is a double pole switch with fuse attachments, *d* and *e* represent respectively an ammeter and a voltmeter, *f* is a main converter, receiving in its primary coil the entire current from the dynamo. The winding of the secondary coil of this converter is 300 times that of the primary, producing, with due allowance for loss of energy in transforming, a current of over 30,000 volts. The measurement of the e. m. f. of this current is made by a Thomson electrostatic voltmeter *g*. The current from the converter is carried overhead on a pole line. The conductors run out and back again on the same poles, a distance of 2½ miles, making the total length of the line 5 miles. The wires terminate in another converter *i*, by which the e. m. f. is again reduced. The current in the tertiary wire can be brought down as low as 50 volts and is measured by the ammeter and voltmeter *k* and *l*. o_1, o_2, o_3 are three banks of lamps of 50, 65 and 100 volts, controlled by switches n_1, n_2 and n_3.

To determine the influence of high tension current on telephone service, a double telephone line was extended between the outgoing and incoming wires on the same cross arms. No report, however, is made of telephone tests.

The greatest difficulty in distributing current at such a high tension is found in securing insulation of the line. It is often found that even a double petticoat insulator will be covered with moisture both outside and inside by sudden changes in the atmosphere. To obtain the most perfect insulation a new porcelain insulator made with a cavity inside filled with a light oil, Fig. 2, was used over the entire line. The result was very satisfactory, as in case of changes of temperature moisture would deposit itself on the surface of the oil, not in a continuous sheet, but in smaller drops. These drops gaining a certain weight, would descend through the oil to the bottom, leaving the surface free. It is stated that during the whole term of experiment from November to February with the converters exposed to every kind of weather, carrying every day a pressure of 40,000 volts, no trouble was experienced and no variation due to leakage on the line was noticed in the meters.



FIGS. 6, 7 AND 8. EXPERIMENTS WITH HIGH TENSION CURRENTS.

Where the lines are long and a large number of insulators would be employed it is proposed to use Johnson & Phillips insulators, such as are represented in Figs. 3, 4 and 5.

Figs. 6, 7 and 8 represent the converter. The coils are cylindrical in form and the laminated sheet iron core is square. The converter is encased in an iron box filled with oil. This case covers the coils entirely. Every particle of moisture and air that might be left in the insulation of the wire is driven out by heating the converter to 250 degrees. The cuts are reproduced from the *Electrotechnische Zeitschrift*.

Wisconsin Electric Club.

At the last meeting of the Wisconsin Electric club at Milwaukee the death of John E. Crotty was announced and the following committee on resolutions was named:

A. J. Rogers, John A. McMannon and W. H. Hyde. The committee reported the following resolutions, which were unanimously adopted:

Whereas, John E. Crotty, a young man full of promise and ability in the art and science of his profession, has suddenly been cut off by the hand of death, and

Whereas, We, the members of the Wisconsin Electric club, had come to know him as a genial, earnest and active member of our association, be it

RESOLVED, That we tender to his parents and family our heartfelt sympathy in this their sad affliction, and

RESOLVED, That a copy of these resolutions be sent to the family of our deceased friend and associate.

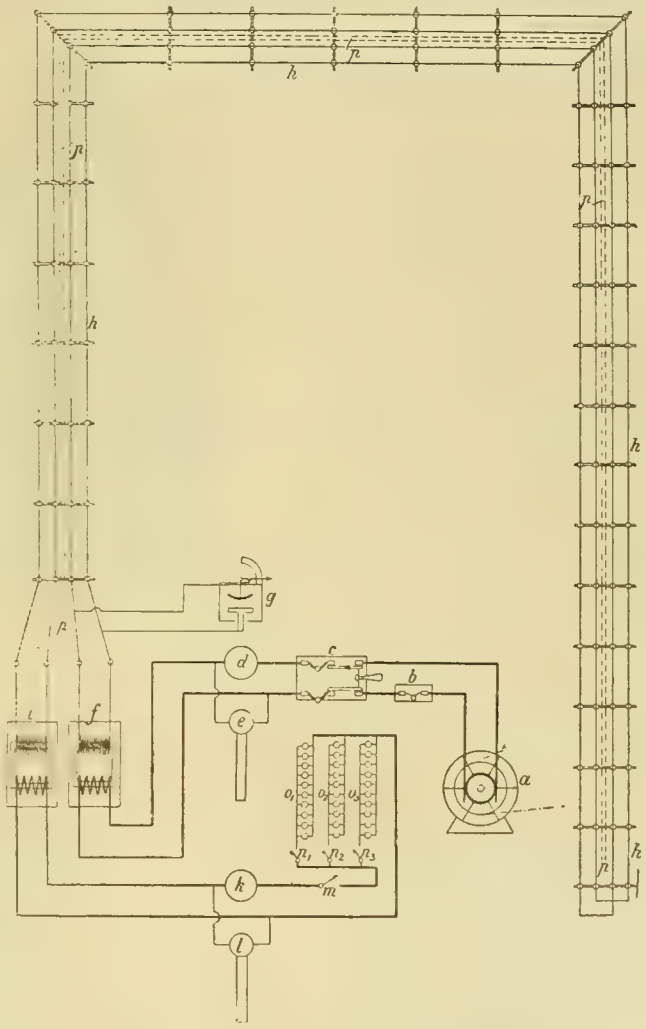


FIG. 1. EXPERIMENTS WITH HIGH TENSION CURRENTS.

American Enterprise Discouraged in England.

According to a London correspondent the American electric call boxes for messenger service created a stir in the British capital last week. When the district messenger service started last year, Postmaster-General Raikes said it could not carry letters without using penny stamps. He was inclined to sniff at the service, anyway, as a silly American device, which would die a natural death if let alone. But when Mr. Raikes discovered that the American idea "caught on," and that the company could not put in call boxes fast enough, he ordered the company to pay up or stop.

The company promptly offered to pay up, though under the protest that no such tax was required of them in America. Driven to the last resort Mr. Raikes told the American company it could not do business on any terms, as he intended to establish a messenger service of his own. When Mr. Raikes' plans were published, showing an absence of call boxes, a row was raised, Parliament and press protesting against Mr. Raikes interfering with the public convenience. Of course, while Mr. Raikes has the government majority on his side he will win in Parliament, but the messenger company intends to carry the matter into the courts, where it feels confident of victory.

According to the press dispatches E. F. Brown has been obliged, on account of the abandonment of the Lake Front as part of the World's Fair site, to give up his plan of making an underground mining exhibit. This will be regretted by electrical people, as it would have made a place for quite an extensive electrical display.

The Giles Automatic Thermostat.

The accompanying cuts illustrate the Giles automatic thermostat. Fig. 1 represents a closed circuit thermostat, which is adjusted by means of a screw on the right. It is made to adjust from 70 degrees to 170 degrees, and has one-half inch movement in 100 degrees. Fig. 2 represents an open circuit thermostat, which is adjusted by means of a lever below the coil, and has an adjustment of 100 degrees above the temperature of the room when placed in position, and has one-half inch movement in

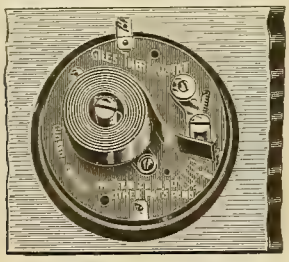


FIG. 1. GILES AUTOMATIC THERMOSTAT.

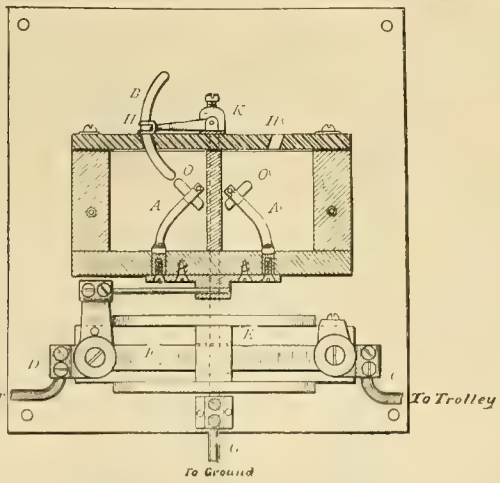
100 degrees. These thermostats are being placed in the market by the Central Electric company of Chicago.

Westinghouse Automatic Street Car Lightning Arrester.

The car lightning arrester illustrated herewith consists of two air chambers, *A* and *A*¹, having vents, shown at *H* and *H*¹, through which the curved carbon *B*, hinged at *K*, can freely pass, swinging from *O* to *O*¹. The carbon point *O* should be set so that it is separated from *B*, when in its normal position as shown in the figure, by one-sixteenth of an inch. The distance from *O*¹ to *B* should likewise be one-sixteenth of an inch, when the curved carbon is in the other chamber. *B* is connected to *G*¹, and *O* and *O*¹ to *D*. *F* is a lead fuse, and *E* an insulating block, provided with a slot, through which the lead fuse is passed. The points *C* and *D* should be connected in series with the motor, and *G* should be connected to the ground as shown in the figure. The action of the arrester is as follows:

When a discharge takes place it passes through the lead fuse *F* to one of the carbons, *O* or *O*¹, depending on the position of *B*, then across the air space to the curved carbon *B*, and from there to the ground, as shown in the figure. The dynamo current then following causes an arc to be established between the carbon *B* and *O* or *O*¹. The heat generated by this arc expands the air in its respective chamber, increasing the air pressure therein, and causes carbons *B* to be instantly blown from one chamber to the other. This ruptures the arc and adjusts the arrester for the next discharge.

In the tests upon this arrester 500-volt and 1000-volt generators have been repeatedly short circuited through it. In every case the circuit has been instantly broken without injury to the dynamo, and the arrester has as quickly set itself in readiness for future use. In one of the tests made to demonstrate its promptness and reliability, carbons *O* and *O*¹ were so adjusted as to touch carbon *B* in either of its two normal positions. A 1000-volt generator was then short circuited through the arrester, which resulted in the circuit being several times automatically opened and closed in one second without injury to either dynamo or arrester. The device is introduced by the Westinghouse Electric & Manufacturing company.



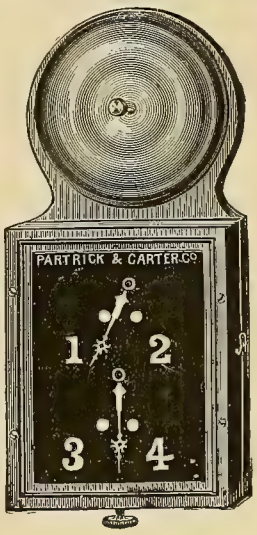
WESTINGHOUSE LIGHTNING ARRESTER.

The King Annunciator.

In the accompanying cut is shown the King annunciator. The device is simple in construction and compact. These annunciators are handsomely finished in oak and walnut frames with glass fronts, and are made with four to eight calls. They are placed on the market by the Partrick & Carter company, Philadelphia.

New Pole Ratchet.

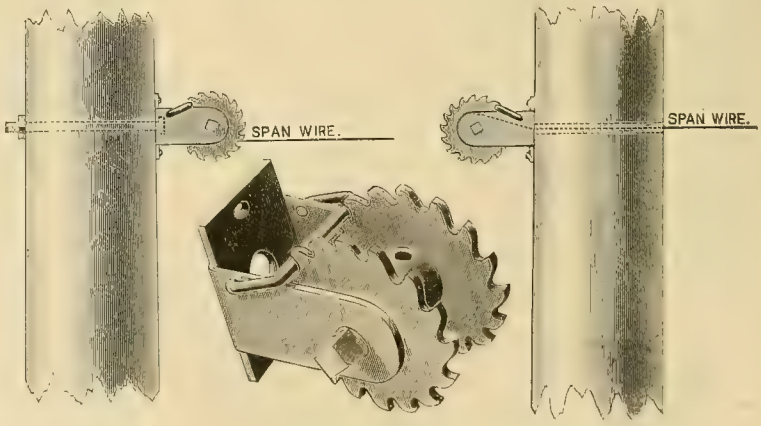
The novelty of the pole ratchet herewith illustrated is more in its application than in itself. The ratchet is well made and shows a decided advance in point of finish. Its weight is less than in ordinary practice, but this advantage, it is claimed, does not sacrifice the strength of



THE KING ANNUNCIATOR.

the device. The latch, as will be observed, engages both sides of the reel.

The ratchet is so designed that it may be used in the old way, as shown at the left in the cut, passing a bolt through the pole and fastening with washer and nut. It is also suggested that there are advantages in the method, shown at the right, in which the span wire is passed through the pole. In this way the use of a bolt is obviated. The device is placed on the market by the Electrical Supply company of Chicago.



NEW POLE RATCHET.

The St. Louis city council has under consideration a bill providing for the operation of all electric wires underground. It has been favorably reported by the committee.

World's Fair Electrical Exhibits.

Two years and over must elapse before the World's Fair will be thrown open to the public, and yet hundreds of applications and inquiries for space have already been received by the electrical department. This fact is significant as giving an idea of the magnitude of the coming display, which is sure to surpass any exhibition of the kind ever given. The prospective exhibitors who have signified their intention of contributing to the success of this department of the exposition have expressed a desire for floor space in amounts ranging all the way

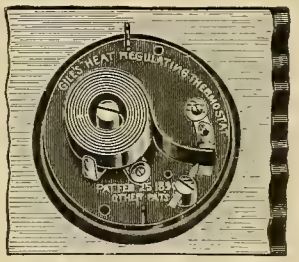


FIG. 2. GILES AUTOMATIC THERMOSTAT.

from 100 to 10,000 square feet. And this is only a beginning on the American exhibits alone! From these facts it will readily be seen that the space in the proposed electrical building will be totally inadequate to the demands made upon it. The display will be a great one, and it will take a larger amount of room than is at present provided.

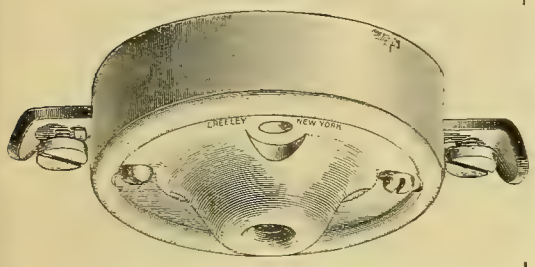
Following is a complete list of the electrical inventors, manufacturers and dealers who have already expressed their intention of exhibiting at the exposition:

Elgin Telephone company, Elgin, Ill.; Electric Merchandise company, Chicago; Electrical Supply company, Chicago; Fort Wayne Electric company, Fort Wayne, Ind.; Fletcher & Fletcher Electric company, Cleveland, O.; Gamewell Fire Alarm Telegraph company, New York; Globe Carbon company, Cleveland, O.; National Telephone Manufacturing company, Boston; C. McIntire company, Newark, N. J.; James H. Mason, Brooklyn; National Electric Manufacturing company, Eau Claire, Wis.; Nowotny Electric company, Cincinnati, O.; Frederick Pearce, New York; Patton Motor Manufacturing company, Chicago; Rockford Electric company, Rockford, Ill.; Rose Electric Light Supply company, St. Louis, Mo.; Standard Electric Time company, New Haven, Conn; Writing Telegraph company, New York; Frank C. Perkins, Ithaca, N. Y.; James W. Queen & Co., Philadelphia; Ries Electric Traction & Brake company, Baltimore; Simplex Electrical company, Boston; Sperry Electric company, Chicago; Thomson-Houston Carbon company, Fremont, O; Tropical American Telephone company, Boston; Thomson Electric Welding company, Boston; Thomson-Houston Electric company Boston; Viaduct Manufacturing company, Baltimore; Western Electric company, Chicago; Westinghouse Electric & Manufacturing company, Pittsburg, Pa.; J. Lang & Co., Chicago; Lowth Stetho Telephone company, Chicago; Illinois Electric Material company, Chicago; Interior Conduit Insulation company, Chicago; Jones Bros. Electric company, Cincinnati, O.; Jenney Electric Motor company, Indianapolis, Ind.; Hall Signal company, New York; Elmer A. Sperry company, Chicago; Accumulator company, New York; Ball Electric Light company, New York; J. H. Bunnell & Co., New York; Foree Bain, Chicago; E. Berliner, Washington, D. C.; M. C. Bullock Manufacturing company, Chicago; Belding Motor & Manufacturing company, Chicago; R. T. Brooks, New York; American Machine Telegraph company, New York; Clark Electric company, New York; Detroit Motor company, Detroit, Mich.; Cleveland Electrical Manufacturing company,

Cleveland, O.; Consolidated Temperature Controlling company, Minneapolis, Minn.; C. & C. Electric Motor company, New York; Commercial Electric company, Detroit, Mich.; Central Electric company, Chicago; Eureka Electric company, New York; Eddy Electric Manufacturing company, Windsor, Conn.; Eco Magneto Clock company, Boston; Elektron Manufacturing company, Brooklyn.

In addition the department has received many other proposals from inventors and others who have developed schemes that they think will enhance the attractions of the fair and likewise redound to the credit of the originators.

Dr. G. P. Hachenberg of Austin, Texas,



CARTWRIGHT PORCELAIN ROSETTES.

whose system of "musical telegraphy" was described in the last issue of the WESTERN ELECTRICIAN, has written a letter giving more of the details of his scheme. He says: "The desideratum in electro music is not to produce an ephemeral novelty, but the highest order of music. An individual note has its defects, and will only render its purity in synchronous action with other notes that are in accord with it. This is a fixed law in harmony. What we expect to gain by our invention is to secure an expression through a combination of notes, under the precision of 'time' which no human manipulation alone can effect. Music transmitted by any telephonic process will never prove a success unless associated as an adjunct with such electro dynamics as we have to propose. In our arrangement let there be a 'telephonic,' tubular or metallic connection between the sounding boards of the ten pianos. Of course the connection has to be diaphragmatic. Such a connection will bring all the instruments in synchronous vibration, if any one is brought into action; for not a note will be struck but its life will be manifested simultaneously in every instrument—not only the same note, but those in accord with it. This is not brought about by electrical means, but by that kind of vibratory affinity between sounds that all piano tuners are familiar with."

Edward A. Hyde of Kenosha, Wis., has invented a gun in which the projectiles are fired by electricity. No gunpowder or other explosive is used, and the inventor claims that the guns can be made of wood or paper and yet be effective at long range. He wants to display his novel ordnance in the electrical department of the World's Fair.

Prof. Barrett is overrun with letters of application from men who would like to be appointed as assistant electricians in his department. They come from all parts of the United States and other countries, and some have been received from New Zealand and New South Wales.

Secretary Hornsby is endeavoring to secure copies of all the electrical journals of the world for the office of the electrical department. His idea is to keep the papers on file in the office. At the exposition the bound volumes of these periodicals will form part of the exhibit of electrical literature, and after the fair closes they will naturally form a portion of the records.

Electric Light Plant Nearest the North Pole.

On the northern coast of Norway, under latitude 70.5 degrees, is situated the little town of Hammerfest. Every year for months the sun disappears entirely and there is perpetual night, only lighted once in a while by a beautiful aurora borealis. The town of Hammerfest has just installed an electric light plant. The International Thomson-Houston Electric company furnished the apparatus and superintended the installation.

There are two dynamos driven by water-power outside the town. One dynamo furnishes current for 12 arc lamps for street lighting. An alternating dynamo of 35 amperes and 1,000 volt capacity supplies private customers with incandescent lights on the transformer system.

This central station plant operates probably under the most economical conditions, as during the winter months it must be kept running continually under full load.

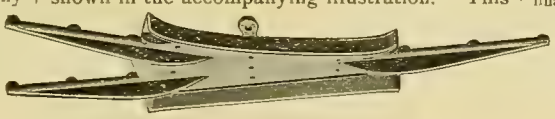
Cartwright Rosettes.

In the accompanying cuts are illustrated two patterns of rosette placed on the market, by the E. S. Greeley & Co. In the plain pattern Cartwright porcelain rosette and the ornamental pattern, the brass connectors to which the wires are fastened have a slight projection from the base underneath the overhanging screw-head, opposite the point where the wire rests when it is clamped. The object of this projection is to prevent undue torsion of the screw when it is turned firmly down to clamp the wire. When there is no such support there is a tendency to throw the screw-head out of plumb and damage the connection, whereas when the screw-head is equally supported on both sides, on one by the wire itself and on the other by the projection, better results, it is claimed, are obtained.

In the Cartwright waterproof cut-out this feature in the connector is not only present, but special stress is laid upon the fact that there are no screw-holes or metallic connections of any kind leading from the inside of this cut-out, that might form contact with a damp ceiling.

Overhead Switch for Electric Railway.

A new overhead electric railway switch is shown in the accompanying illustration. This



OVERHEAD SWITCH FOR ELECTRIC RAILWAYS

device is the invention of W. H. S. Wright. It will be noticed, by referring to the cut, that the switch is supplied with a flange on either side and a slot running parallel with the flange. The operation of the switch is as follows: When the trolley wheel strikes the switch, the flanges on the wheel run into one or the other of the grooves corresponding to the direction the car is taking on the ground switch, thus following the overhead wire without any attention from conductor or motor man.

Three clamps on the back of the switch connect it to the trolley wire. The center clamp is elongated and has a hole in either end for the suspension wire and head guys. These switches are constructed of brass and are made for right and left turnouts and also for Y's. They are milled to fit any size trolley wire. The Knapp Electrical Works has the right to manufacture the device.

Ruinous Competition.

The electric light companies of Waco, Tex., are engaged in a rate cutting war that cannot fail to end disastrously, if the reports from that city be correct. The city is furnished with thirty-three arc electric lights at $12.50 per light per month by a corporation called the Waco Gas company, which also owns an electric light plant. The city advertised for bids for furnishing fifty additional arc lights for the streets to run all night. A new company, called the Waco Electric Railway Light company, put in a bid of $11 per month per light, which was $1.50 under the price the gas company gets for the existing thirty-three lights. When the bid of the old company, the Waco Gas company, was opened there was a sensation. That company offered the fifty additional arc lights at 90 cents each per month. The award was made to the old company, with the condition attached that it give bond in the sum of $5,000 for the faithful fulfillment of the contract. The bond has been filed, but the new company is going on building its plant, hoping to capture the private patronage for incandescent lights.

An electric railroad from Tryon City to Asheville, N. C., will be built.

Electrical Building at the World's Fair.

The statement made by the WESTERN ELECTRICIAN last week to the effect that there was every reason to believe that the construction department of the World's Columbian Exposition intended to proceed with the erection of the proposed electrical building at the World's Fair excited much interest in electrical circles. The decision of the construction department to ignore the suggestions of the representatives of the electrical interests and disregard their protest against the adoption of the original plans was received with marked disapproval. It was generally agreed that to proceed in this manner would certainly antagonize the electrical interests and this, of course, would insure the failure of the grand project which the entire electrical fraternity has been so confidently expecting since the location of the fair was determined.

It was hoped when the question of dividing the exhibit and placing part on the Lake Front and the remainder at Jackson Park was abandoned that the directors realized the importance of having the entire electrical exhibition in one building. The determined opposition to the Lake Front project does not seem to have impressed the construction department with a realization of the storm it is inviting by advocating a divided electrical display.

In order to secure an official announcement on this subject, the WESTERN ELECTRICIAN addressed a communication to Chief Burnham of the construction department, submitting the following questions:

Is it not true that the plans for the proposed electrical building provide for a structure only 350x750 feet?

Is it not the intention to complete the plans for this building according to the present dimensions; and, so far as your office is concerned, are not these plans considered final?

Is it not true that the location of the proposed building is such that, in case more room will be required than is now provided for, it would be inconvenient, if not impossible, to enlarge the proposed building?

Is it not your intention to provide for the placing of a large number of the heavier exhibits in other buildings?

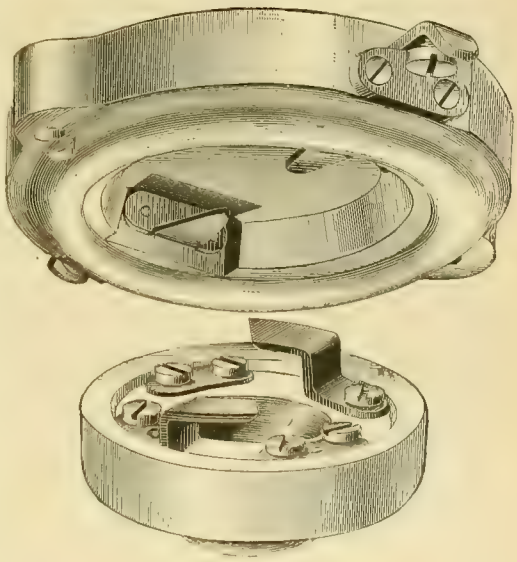
What are those exhibits and in what buildings do you propose to dispose of them?

In case the present plans are rejected or prove to provide too little space, how long would it be before new plans could be prepared?

If a change in your plans as at present drawn should prove to be necessary, would it not be a great saving of time to change them immediately rather than to complete them on the present basis, and, after completion, change them?

Is J. P. Barrett, Chief of the Bureau of Electricity, fully acquainted with your plans for the proposed electrical building and for the disposition of the electrical exhibits, and have these plans received his approval?

Of course you are aware that at the Paris Electrical Exposition in 1881, ten years ago, the Palais de l'Industrie,



CARTWRIGHT'S WATERPROOF CUT-OUT.

810 feet long and 350 feet wide, with a gallery 75 feet deep extending all around the building, was completely filled with electrical exhibits. It is true that the power plant for driving the electrical machinery was included in this building, and we know that your plans provide space for the power plant outside of the building. Still, there have been ten years of most wonderful advancement since that time, and the Palais de l'Industrie was larger than the electrical building at Jackson Park is planned to be.

Moreover, there were only two motors used in the Palais de l'Industrie, and the power plant was very small. If we take into consideration the advancement in electrical industries since 1881, and the probable progress in this field for the next two years, and also remember that in the United States in 1881 there was probably not more than $1,000,000 invested in electric lighting, while to-day the lowest estimate places the investment in central lighting stations alone at $150,000,000, and the total amount of money invested in operating electrical apparatus at probably $500,000,000, do you not think that the building which is proposed for Jackson Park is ridiculously small?

Chief Burnham, in a communication to the WESTERN ELECTRICIAN, acknowledged the importance of the subject under consideration and promised to give the matter his most careful consideration. In conversation with a representative of the WESTERN ELECTRICIAN he said that it was true that the dimensions of the proposed electrical building would be only 350x750 feet. Producing a blue print showing the location of the buildings at Jackson Park, Chief Burnham pointed out that it would be necessary to change the entire plans if another site for the electrical building should be selected. The enlargement of the proposed building as at present planned is out of the question. It is proposed to place this structure in a prominent position near the main entrance and facing the administration building. It would have every advantage if it provided for ample floor space, but this most important feature is wanting. Mr. Burnham admitted that it was the intention of the department to provide for the display of electric railway apparatus in the Transportation building, and that much of the heavier exhibits would be placed in Machinery hall. For instance, the generating plant from which current will be supplied for the operation of electrical apparatus in the electrical building, and also for lighting the structure.

It appears, according to Mr. Burnham's statement, that the plans for the allotment of space for the several buildings were approved by the directors and national commissioners in October last, and that any change in the plans will require the approval of both the directors and commissioners. From this it would appear that the space at present allotted the electrical building is less than was proposed when it was intended to hold an exhibit at the Lake Front. Therefore the electrical interests are doubly justified in protesting against the inadequacy of the present provisions, as they are less than was originally intended. It was further admitted that a change in the plans could only be made at a sacrifice of the artistic appearance of the buildings and grounds.

Concerning the comparison between the proposed exhibit and the electrical exhibition of 1881 at Paris, Mr. Burnham said: "I think the only objection the electrical interests can make is on the division of the exhibits. You will find that they will have all the space required for a display of apparatus, but it must necessarily be divided. This was decided by the classification of exhibits, which was approved by both boards, national and local, and all that remained for us to do, was to follow the lines indicated in the classification. It is not the electrical interests alone which want more space; every department is calling for larger buildings. If all these demands were granted we would have to double up the space."

Mr. Burnham stated that an electric railway 2,700 feet long would be constructed inside the "loop" and around the "machinery annex." This is a circular building and so situated that it will bring the electric cars under the observation of every visitor to the grounds.

Charles H. Wilmerding, secretary and treasurer of the Chicago Arc Light & Power company, in conversation with a representative of the WESTERN ELECTRICIAN, said: "I have no hesitation in expressing my belief that the building as at present planned is altogether too small for the electrical display. A number of us called on Mr. Burnham a short time ago to inspect the plans. If I remember rightly the drawings called for a building 675 feet long and 350 feet wide. Of course, that would make a large structure, but it would not be large enough, as we thought at the time. A day or two after that we sent out a number of inquiries to prospective exhibitors to get an approximate idea of the space that would be required. From the replies that we received we readily perceived that the floor space in the building would be totally inadequate. If the building is erected after the original drawings, this will result in crowding many of the exhibits in other buildings, which will detract from the general effect of the display and be undesirable in many ways. I do not think that the building will be large enough for the American exhibits alone at the present moment, to say nothing of the showing that will be made by the electrical interests of the world two years hence, when, of course, electrical development will be much greater. Why, I understand that in expositions of former years more space was devoted to electricity than it is proposed to provide at the World's Columbian Exposition. Apparently those in charge of the affair do not realize the rapid progress that has been made. But the gentlemen in charge of the construction department are responsible for the provision made for the display, and they must bear the praise or blame for the result. I do not wish to appear in the light of criticizing them; I simply express my individual belief."

Mr. Wilmerding further said that he was in favor of a surface out-door road for the display of electric railway systems. He thought that probably the intermural transportation line could be utilized for that purpose.

Lieut. F. B. Badt, who is chairman of the committee appointed by the Chicago Electric club to collect statistics relating to the space occupied by electrical exhibitions, has gathered much valuable information on the subject. He is satisfied that the floor space of the proposed electrical building of the World's Columbian Exposition is not sufficient, and he bases his assertion on the statement that the building is to cover a floor space of 675 by 350 feet, or 236,250 square feet.

When asked to tell something about the dimensions of the space accorded electrical exhibitions of former years, Lieutenant Badt said:

"The Paris electrical exposition of 1881 was held in the Palais de l'Industrie. This building is 810 feet long and 354 feet deep. It has a gallery extending all around the building, about 75 feet deep. It was completely filled with electrical exhibits in 1881, and the French paper *La Nature* says: 'In 1881 the building was too large for a Universal Exhibition, but to-day we find it too small for an electrical exhibition. The objects of the exhibits are all modern inventions, which were absolutely unknown only a few years ago.' Assuming the floor space covered by the electrical exhibits in round figures at 520,000 square feet, the floor space of the electricity building for the World's Columbian Exposition is only 45 per cent. of that of the Palais de l'Industrie. If we take into consideration the advancement in electrical science and electrical industries since 1881 and the probable progress in this field for the next three years, we must come to the conclusion that the place provided for the electrical exhibits in 1893 is entirely inadequate. The capital invested in the United States in electric lighting in 1881 was certainly less than a million dollars, and electric lighting was in its infancy, while to-day, at the lowest estimate, $125,000,000 is invested in central lighting stations alone. The increase in the number of arc and incandescent lights for the last six months in the United States amounts to 30 per cent.

"The American exhibits during the Paris Universal Exhibition of 1889 covered a floor space of 100,000 square feet, one-half of which was covered by electrical exhibits only. The Edison exhibits alone covered 9,000 square feet. If the American electrical exhibits in Paris in 1889 covered 50,000 square feet it is fair to assume that American exhibitors in their own country in 1893 will cover at least ten times this floor space. This would mean for American exhibits alone twice the floor space laid out for the electricity building, and no space would be provided for the foreign electrical exhibits.

"The total floor space of the Franklin Institute Exhibition in Philadelphia in 1884, including the annex, covered about 134,000 square feet. The nature of the exposition was purely electrical, and when the estimates were prepared for the necessary floor space 80,000 square feet was considered ample, but before the opening of the exposition the Pennsylvania railroad station had to be appropriated as an annex. In addition to the floor space in the building mentioned a large lot and also part of Thirty-second street was appropriated for experimental purposes.

"The American Electrical Exhibit of 1884, given in Boston, was held in a building 600 by 345 feet. The part devoted exclusively to electrical exhibits was of triangular shape, with a basement, first floor and gallery. The dimensions were 295 feet by 384 feet, with an estimated floor space of about 246,000 square feet. This exhibition, following so closely on the Franklin Institute Exhibition, furnishes valuable data from which comparisons may be drawn, and shows that within that short time the demands for floor space for electrical exhibits had increased nearly 100 per cent."

Professor Badt has also ascertained that the space provided at the electrical exhibition to be opened at Frankfort-on-the-Main, Germany, on May 1st, will be 538,000 square feet, nearly twice the amount provided for the Chicago exposition of 1893, and yet the Frankfort exhibition is described by one who is well acquainted with its features merely as "a sort of Western Germany exposition."

Myron A. Knapp, secretary of the Knapp Electrical Works, when asked for his opinion of the matter, replied: "Of course the proposed electrical building is too small. It won't begin to hold all the electrical exhibits that will be offered. Why, I should not be suprised if the electrical department was not only relatively but actually larger than the the mechanical department. The trouble is that the gentlemen of the construction department do not realize the magnitude of a display that will adequately represent the electrical industries of the world in 1893. This is not to be wondered at, as it is difficult for one not connected with the devolopment of electrical science to appreciate the wonderful extent of the progress that has been made in the last few years. One thing is certain, and that is that the electrical exhibits of the fair will be one of the most attractive features to the general public. People like to see electrical machinery and the applications of electricity, and the building is sure to be thronged from morning till night. Our experience when we had the display here in connection with the electric light convention of 1889 proves the truth of this statement."

B. E. Sunny, general Western manager of the Thomson-Houston Electric company, when asked what he thought of the contemplated action of the construction department, said: "My views are exactly in accordance with those expressed in the editorial in the last issue of the WESTERN ELECTRICIAN. I think that the electrical building as planned is altogether too small, and that some arrangement should be made whereby it can be increased in size, or else provision made for an addition when necessary. I am sure that this is the general opinion of the electrical men who are cognizant of the facts of the case. In regard to electrical railways, I am in favor of a surface road, on which all the systems exhibited could be displayed in actual operation. This road should, I think, be used for the actual transportation of passengers on the fair grounds, and no particular system should be favored more than another. There are many objections to an elevated structure, and I think that the directors will hesitate a long time before authorizing the construction of a railroad that will cost from $1,000,000 to $1,200,000 and then be only suitable for one system."

F. W. Cushing, secretary of the Central Electric company, Chicago, has taken a lively interest in the preparations for the electrical exhibit at the World's Fair. He agreed fully with the expression of opinion in the WESTERN ELECTRICIAN regarding the inadequacy of the provisions for the electrical department. "As I understand it," he added, "the building now under consideration is not as large as those in which former electrical exhibits were held. That in which the electrical display at Paris in 1881 was made was 810 by 375 feet. Besides

this there was a gallery 75 feet deep extending around the entire hall, and it, too, was crowded. It should be observed in this connection that the practical application of electricity has made its great advances since that time, that the motor has been developed into a commercial article,that welding by electricity was not known at that time—in fact, that all the most familiar forms of application of this great agency were practically unknown then, and of course found no place in the exhibition. The building contemplated at Jackson Park is really not large enough for the accommodation of American exhibitors. Think of the strides that have been made in this country in the last few years, of the activity on all sides at the present time, and we can easily see how far from accommodating the needs of the industry is this building. It is certainly to be regretted that the plans have been permitted to progress thus far and reach their present state. The mistake was made in not securing at the start the views of those most interested—the prospective exhibitors—so that provision could be made for ample accommodation. I hope it is not now too late to effect the desired change."

Franklin S. Terry, manager of the Electrical Supply company has taken an active part in all that has been done by the electrical interests in World's Fair matters. When questioned as to his opinion of the dimensions for the proposed building for the electrical department of the World's Fair, Mr. Terry was very emphatic in his objections. "Why," said Mr. Terry, "it is proposed by the directors to give a creditable and representative exhibit of the electrical industries in a building with a smaller floor space than that used for the same purpose in Paris at the recent exposition, and the Palais de l'Industries held in the same city several years ago. At the present rate of increase, the electrical industries will have doubled in volume by 1893, and it is fair to presume that before we have the World's Fair many new applications of electricity will be operating on a large scale. In estimating on the necessary space, we must allow for all such possible contingencies.

"The electrical exhibits previously held in this country have been only partial displays on a comparatively small scale, but from the space taken, we can determine without a particle of doubt that the proposed World's Fair building will be entirely inadequate to the requirements. As this will be the first complete exhibit in the country of the more important electrical devices in use to day, it has been decided to make it on as grand a scale as possible, that it may truly show the wonderful growth of the electrical industry, and as such it will be one of the main features of the whole fair.

"The Electrical department is entitled to more consideration than the older lines of exhibits, for the reason that the general public has but a faint conception of the applications of electricity, and it is important that we show them what has been accomplished in as complete and impressive a way as possible, that they may be educated to a knowledge of the true state of affairs, to the end that electricity may come into more general use.

"The electrical people are prepared to give both the necessary time and money to do their part, and all that is asked is sufficient space in one building to make a complete exhibit of the entire electrical industry. There will not be the same interest shown if part of the exhibits is crowded out of the electrical into outside buildings. I am convinced that the electrical building should be at least one-half larger than the one contemplated."

Mr. Terry is very desirous that every effort possible may be made to induce the directors to enlarge the building sufficiently to meet all necessary requirements.

That the importance of the announcement was fully appreciated by the representatives of electrical interests will be seen from the following communication from B. E. Sunny, chairman of the World's Fair committee of the Chicago Electric club, to John P. Barrett, Chief of the Bureau of Electricity, World's Columbian Exposition:

You will remember that a few weeks ago the Chicago Electric club committee on World's Fair matters passed a resolution calling the attention of the World's Fair directors to the size of the building at Jackson Park set apart for the electrical exhibit, and stating that the building as designed would be wholly inadequate to accommodate the demands upon it. No word has reached the committee that this matter is receiving any attention, with the view of changing the dimensions, but on the contrary the indications are that the building will remain as originally planned.

The electrical people are very much disturbed and are emphatic in their request that a much larger building be set aside for their purpose. They deplore the possibility of the electrical exhibit being divided among several buildings, on account of the building allotted for that special purpose being too small, and I am very confident from the way that they talk and feel on the subject that their interest in the fair and in the electrical exhibit will be very much lessened by any action which seems to limit them to less space than they are entitled to, and ought to have.

You understand the situation so fully and the enormous growth of the electrical business during the past few years that we trust that you will give this matter immediate attention and use your best endeavors and influence to assist us.

I write you as chairman of this committee and desire to have you consider this letter, together with the resolution that has been submitted, as a formal protest against the completion of the World's Fair electrical building in accordance with the present inadequate plans.

The Electrical Association of Pennsylvania.

A meeting of representatives of electric lighting companies of Pennsylvania was held at Harrisburg recently and an electrical association was formed. "The following officiers were elected: President, Robert E. Wright, Allentown, Pa.; vice-president, J. K. Ewing, Uniontown, Pa.; secretary and treasurer, Clarence A. Wolle, Bethlehem, Pa. Executive committee—D. Hyman, Harrisburg, Pa.; John A. Latham Mahanoy City, Pa.; B. F. Overholt, Scottdale, Pa.; P. J. Ferguson, Shenandoah, Pa.; E. D. Mullen, Philadelphia, Pa. "The object of the association is expressed in the constitution as follows: The objects of the association shall be for the proper development of our business, for mutual protection and information, and to determine the best methods for assisting our state and local authorities in the formulation and enforcement of such laws and rules as will conduce to the best interests of the community."

Light and the Eye.

Dr. Lucien Howe gave an interesting talk at the meeting of the Buffalo Electrical society, March 16. His subject was "The effect of Electric Light upon the Eye." Dr. Howe explained with the aid of a model the construction of the organ of vision. He wished principally to demonstrate what parts of the eye were affected by light, to what degree they were affected and the cause. He said there were three essential features in good illumination. "First, a minimum amount of heat; second, constancy (no flickering), and third, a sufficient amount of white light. It will therefore be seen that the typical artificial light would have the least amount of heat, the greatest regularity or steadiness, and the greatest possible purity or whiteness. These requirements are fulfilled by the arc light except that thus far it has not been made sufficiently regular; it flickers."

Continuing he said: "The normal or daylight, of course, fulfills the conditions I have named better than any other. Of artificial lights, however, electricity is better than either gas or oil. The different methods of artificial illumination have been very accurately stated by several observers, not only because of their importance financially, but also of their effect medically on such an essential organ as the eye."

Under certain conditions Dr. Howe believes the incandescent is the ideal artificial light. The arc light, if properly improved, especially if made more regular, he thinks might be as good or better than the incandescent.

Dr. Howe said that it rested with the electricians to make the electric lights more regular, and that until they are perfectly regular the best light cannot be had. Even after they have been made perfectly regular, he said, electric lights cannot be used for house illumination, that is, not until they are properly shaded, as with ground globes or something of that sort, because the light would otherwise be too intense for house use.

Speaking of the effect of the electric light on the atmosphere, he said: "It should be noticed especially of the electric light, that it does not vitiate the atmosphere in the least, no matter how long it burns. This is a very important point, not only so far as the comfort of the eye is concerned, but also the health of the individual. The blackened walls and ceilings of our houses attest only too clearly the amount of particles of coal dust which in infinitesimal quantities is given off from the lamp when it burns. These particles, of course, redden the eye more or less when they come in contact."

It is quite likely that the executive board of Rochester, N. Y., will decide to operate all of the lift bridges over the Erie canal in that city by electric power. It is estimated that the necessary machinery can be installed for $35,000. Should the change be decided on, bids for the electrical equipment will be solicited from all electric companies.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 28.—Mayor Grant threatened to resume his attack on overhead wires this week. In fact he went so far as to order the destruction of the poles on Thirteenth street. In accordance with his instructions Commissioner Gilroy of the Board of Public Works prepared to organize his brigade of pole choppers and sent word to the Metropolitan Telephone Company that if its wires on Thirteenth street were not removed he would take the matter in hand himself. The counsel for the company, however, secured an injunction restraining the authorities from interfering with the wires and poles. The writ was issued on the ground that no subway has as yet been provided in the street, and that as soon as one is completed the company will discontinue its overhead system. That there is a demand for an underground electric railway system is true beyond a question, and just so surely all electricians believe the problem will be solved. It would not be surprising if the two New York companies that are now introducing cable lines would find it necessary within a comparatively short time to follow the example of the Minneapolis Railway company and discard their cable equipment to adopt an electric system of some kind. The public, too, have no little interest in the matter. During the progress of the work they will be subjected to an immense ammount of inconvenience. They will not be gratified if, after the completion of the work, the system is found to be unsatisfactory and uneconomical, and must ultimately be discarded.

No cable system can give the rapid transit which is the demand of the hour. Local papers are full of suggestions in regard to the improvement of transportation facilities and some sort of relief is urgently demanded. The electrical fraternity at least is inclined to the belief that the underground electrical system affords the only means of solving the problem. There has been considerable discussion relative to the advisability of remodeling the elevated railway system, but the plans thus far suggested do not give promise of permanent relief. The construction of an extra track which would make it possible to run additional express trains would unquestionably be a great temporary improvement.

The vestry of Trinity Church has for a long time considered the question of lighting the edifice by electricity. There has been, however, some objection to this method of illumination, for the reason, perhaps, that the "dim religious light" of the church was thought, possibly, to enhance the solemnity of the services. The vestrymen, however, have just determined to make the experiment of lighting the chancel, and a hundred incandescent lamps will be used for this purpose. It is said that one great advantage of the new system of lighting will be that it will disclose to view the beautiful traceries of the marble memorials, which heretofore have been almost invisible to the congregation. Eventually the entire church will be lighted by electricity. It will be remembered that for a considerable time electric motors have been employed in blowing the organs in the church, and the success which attended their use doubtless caused the vestrymen to favor an electric system of illumination.

Whenever a mysterious fire occurs it is always customary to assume that electric wires are the cause, if a building is electrically illuminated. A case of this kind has recently come to light in this city. A building was burned in Brooklyn last winter, and the fire authorities, unable to assign any other reason for the conflagration, announced that it was due to a cross of electric wires. It is now ascertained, however, according to the statements of the police, that a fire bug who has been terrorizing the occupants of apartment houses in the lower part of Brooklyn for several weeks, was responsible for the conflagration of last winter also.

The meeting of the New York Electrical society was held at the rooms of the Electric club last Friday evening. Joseph Wetzler lectured on "Electrical Progress in 1890." He spoke of the advances which had been made in electrical work all along the line. Among those who were present and took part in the discussion were, Nikola Tesla, P. B. Delany, J. C. Chamberlain, J. J. Carty, C. O. Mailloux, F. J. Patton, J. C. Henry, Dr. W. E. Geyer, W. H. Bristol and G. W. Walker. The meeting was one of unusual interest. W. H. T.

Pittsburg, Pa.

PITTSBURG, Pa., March 28.—The electric lighting of this city is about to be increased. There are now about 900 arc lights distributed over the streets of Pittsburgh, but that number has for some time been a great deal too small, owing to the rapid growth of the city. To supply this demand the Department of Public Works is now making ar-

rangements for an increase of one hundred and sixty arc lamps, which are to be placed on the thoroughfares of the south side of the city.

The annual meeting of the East End Electric Light company of this city took place a few days ago. At this meeting A. T. Rowan, the former president of the company, resigned his position and J. H. Willock was elected in his place. The annual report shows the gross earnings of the concern for the year 1890 to have been $88,344.39; the operating expenses of every kind $47 610.41, showing the net earnings to be $40,733.98. The surplus on January 1, 1890, was $15,574.77. The total assets of the company are $893 887.08 and the liabilities $758,711.60. The capital stock is $500,000.

The East Liberty power house of the Citizens' Traction company was damaged by fire on the morning of March 24th to the extent of $30,000. No cause has been assigned for the origin of the flames, which at the time of their discovery had attained considerable headway. The company has commenced the work of repair, which will be carried forward with the greatest possible dispatch. Meanwhile, the operation of the road continues as before the fire.

E. H. H.

Kansas City, Mo.

KANSAS CITY, MO., March 28.—The committee appointed some weeks ago by the Builders and Traders' Exchange to investigate the condition of electric wires in the public buildings of the city has made its report. After citing a number of fires caused by improper wiring the report concludes by recommending the appointment of "a board of electrical control, composed of citizens of this city and property owners, to consist of the chief of the fire department, superintendent of buildings and an electrician to be appointed by the mayor of the city. The first two to receive no additional pay; the electrician to receive such compensation as may be agreed upon by the common council."

The adoption of laws and rules for wiring of buildings for electric light is recommended.

A petition was also prepared which will be presented to the council. This will be signed by the officers of the exchange. At the next meeting of the council a committee of members of the exchange will present a petition asking for the appointment of an electric wiring inspector and the adoption of ordinances governing the matter referred to.

The sheriff was compelled to release the rolling stock and property of the Ivanhoe Electric Motor line to the company this week. An execution was obtained against the road by the Kansas & Texas Coal company on Monday for an old debt of $3,000. The injunction was released on the ground that the present motors are the property of the Thomson Houston Electric company, and not of the old Vine Street Motor company.

The telephone company has completed its survey of the streets along which it contemplates placing its wires underground. It has prepared plats of all the down town business streets, showing all the surface and underground improvements, and also maps showing the alleys which it contemplates using, so that it is ready at any time to begin work. No franchise to go underground will be asked for, however, until it has been decided where the exchange will be removed, which matter is still in doubt.

Col. D. B. Dyer of Augusta, Ga., president of the Augusta Railway company, is in the city for a few days. Col. Dyer manages the entire electric street railway system of Augusta, an enterprise in which Messrs. Jarvis & Conklin of this city are interested. He is president also of the Augusta Electric Light & Motor company, a separate organization, but owned practically by the same men.

An electric wire is not usually considered a desirable thing to toy with, and most men would not care to attempt to steal wires from electric light poles. Kansas City thieves have been making this line a specialty and they have never made the mistake of tackling a live wire. They help themselves only to the very best copper wire. The American Electric Light company has lost over $300 worth of wire in the last few days owing to the depredations of the electric wire thieves. On Sunday night the electric light wires on the Ninth street incline plane were carried away. Last Friday night the wires which connect Hannon & Dixon's saloon with the electric light plant were captured. Yesterday Mr. Hannon spoke about the theft, and glancing up at four o'clock in the afternoon he noticed that the wires to E. H. Ormsby's saloon were all right. Yet when darkness came the connecting link between the electric lights of the saloon and the electric light plant had disappeared. It is evident that the wire must have been stolen in the day time in full sight of the crowds passing the Junction between four and seven o'clock in the afternoon.

P.

Portland, Ore.

PORTLAND, ORE., March 26.—The city electric lighting contract has been awarded to the Willamette Falls Electric company for arc and incandescent lights. The term of the contract is two years.

The time has now expired for bids on lighting the building of the North Pacific Industrial association, this city. The company says it will accept a plant only after most elaborate tests.

The Edison company has secured the contract for lighting the new Marquam building, including the theater.

City Electrician A. J. Coffee was called to San Francisco last week to attend the funeral of his father.

E. H. Gates, representing the Westinghouse Electric & Manufacturing company, is in the city.

The electric cars are now in operation over the New Madison street bridge. They run very smoothly and are very much preferable to the old ferry transportation. The Westinghouse system is used. The bridge will be operated by electric motor and the necessary apparatus is now installed.

East Portland will soon have a complete electric plant for city lighting.

Several new plants have been started recently at Vancouver, Wash.

The Metropolitan Street Railway company is extending its line southward to Paletine Hill with the intention of pushing it through to Oswego and Oregon City at an early date.

Messrs. Shurtz, Tobin & Cannon are moving into new quarters at No. 170 Second street, where they will carry a line of manufacturers' and electrical supplies.

P. O.

Denver, Colo.

DENVER, Colo., March 28.—The City Street Railway company has just completed a contract with the Fairmount Cemetery company to extend a line east on Alameda avenue from its present line to the cemetery. The proposed line will be six and a half miles in length and of broad gauge and the heaviest capacity. Funeral cars suitable for forty persons and the casket will be put on the line.

The Riverside Cemetery association is now negotiating with the City and Tramway companies for a line to their grounds on the east of the city, and there is little doubt that the line will be constructed.

The work of changing the Berkely motor line into an electric road will begin April 1 and is expected to be completed within thirty days.

At a meeting of the town trustees of Highlands last week the Denver and Highland Electric Light & Power company ordinance granting the right to construct and operate an electric light and power plant was passed. The company must have within sixty days 10 per cent. of the entire plant in operation, ten miles of wire strung in ninety days and twenty miles of wire strung in four months.

F.

Omaha, Neb.

OMAHA, March 28.—Two bills have been recently introduced into the legislature relative to telephone rentals. One provides for a uniform rental of $1.50 per month; the other $2 per month for business houses and $1 for residences. Both of the bills were referred to a committee which recommended that action be postponed indefinitely. They were, however, placed on the general file for future action. It is not probable that either will be heard of again at this session. Present rentals in Omaha are $5 per month a distance of half a mile from the exchange, and fifty cents additional for each quarter of a mile or fraction above that.

The Midland Electric company of Omaha has gone out of business, being succeeded by the Western Electrical Supply company which will do an exclusive supply business.

The American District Telegraph company has just introduced the Holmes' burglar alarm system, and is now preparing to establish an extensive automatic fire alarm system. The National Automatic company's machinery is used.

The Electrical Engineering company has just been incorporated in this city. The object of the company is the construction of lines for lighting and power purposes, electrical engineering works of all kinds, the purchasing of electric patent privileges and franchises, etc. The authorized capital is $25,000, and B. D. Kennedy, R. B. Howell, J. P. Allen, H. E. Chubbeck, and Fred E. Allen, are the incorporators.

The fight concerning the granting of a charter to the Ballou Electric Light company, was renewed Tuesday night when the proposed ordinance in which the company is interested was called up and made a special order for the next meeting of the city council. A franchise will undoubtedly be granted.

The city council this week granted a charter to a new corporation to be known as the Metropolitan Street Railway company to build from the business portion of South Omaha out to Farnum street. The line is to be completed before July 1, 1892. The charter is for twenty-five years, so that it will expire at the same time as that of the other street railway companies. Such prominent and well-known Omaha business men as Herman Kountze, W. A. Paxton, and W. J. Albright are at the head of the new enterprise. Mr. Albright will be in charge as general manager. The officers profess to have started the new company as a means of securing reduced fares. They say that fifteen miles of the new road will be in operation within ten months. There is almost unlimited capital behind the project. Electricity will be the motive power.

C. H. C.

Sioux City, Ia.

SIOUX CITY, March 28.—At a recent meeting of the city council a franchise for an electric railway upon Court street was given to the Sioux City Electric Street Railway company. Track laying was begun at once and work is now being pushed as rapidly as possible. A fire in one of the company's barns resulted in a loss of $75,000.

The Gould Electric company has secured the agency for the "C. & C." Motor. This company reports a good business already, and bright prospects.

An isolated 400 light plant has recently been put in the Booge hotel.

Work is progressing rapidly on the Highland Park railway.

B.

PERSONAL.

G. W. Atterbury, formerly of the Westinghouse company, has accepted a position with the Short Electric Railway company.

A. V. S. Saunders, of Beatrice, Neb., was in Chicago last week, in the interests of the electric light and railway plants of Beatrice.

Edward Higgins has resigned from the Thomson-Houston company and will hereafter be with the Short Electric Railway company.

ELECTRIC LIGHTING.

An electric light plant is to be established at Ashland, Ky.

The Wateree, S. C., oil mills will put in an electric light plant.

At Shendon, Va., an electric light and power station will be established.

Martinsburg, W. Va., will vote on the question of erecting a lighting plant.

The capacity of the electric light plant at Morristown, Tenn., has been increased.

The Buena Vista, Va., Electric Light company will increase the capacity of its plant.

Pulaski, Tenn., has petioned the legislature for authority to issue bonds for electric lighting.

An electric light plant will be established at Newport, Tenn., by North Adams, Mass., capitalists.

It is stated that the present gas works of Americus, Ga., will be superseded by an electric light station.

The Greeneville, Tenn., Electric Light company will put new incandescent lighting machinery in its plant.

The Clarksdale, Miss., Water, Light and Power company has been incorporated with a capital stock of $100,000.

The Yazoo City, Miss., Improvement company has been incorporated to construct waterworks and electric lighting and heating plants; capital stock, $100 000.

It is reported that the Citizens' Electric Light company of Galveston, Tex., will increase the capacity of its plant by adding a 500 horse power dynamo and four boilers.

It is said that A. H. Reece, the Pacific coast manager of the Edison company, has announced his intention of putting a plant in every city on the Pacific slope that has a population of 10,000 or over.

Bids for street lighting for two years have been advertised for by the city of Portland, Ore. The specifications call for 100 arc lights, more or less, of 2000-candle power, and 800 25 candle power incandescent lights.

It is reported that the Middlesborough, Ky., Electric Light, Heat & Power company, will erect a new electric-light plant, with a capacity of 3,000 incandescent and 800 arc lights, which can be doubled without any further additions of machinery.

The Hartford, Conn., Electric Lighting company has installed six dynamos at a new station near Rainbow, on the Farmington river, ten miles from the city. The plant is operated by water power, six horizontal water wheels being used. Four more dynamos and a 300 horse power generator are to be added.

The suit of the Southern Brush Electric Light company against the Louisiana Electric Light company and the

Brush Electric Light company, is pending in the United States court in Louisiana. The complaint alleges that in June, 1881, the Brush company made a grant to the complainant of the sole right to sell, rent and use the patented improvements in the arc lamps of that company within the state of Louisiana. It is claimed that the defendants evaded the terms of the grant, causing great loss to the complainant.

A San Francisco agricultural editor says it is only a question of time when the picking of fruit will be done by electric light, on account of the greater coolness of the night air being better suited for that purpose. This is said to be particularly applicable to the picking of the apricot, which cannot be done rapidly, as it ripens in daylight, and the delicacy of which makes it so quickly perishable that much is lost every year. He thinks that the use of an electric light plant, which could be moved readily from one part of the orchard to another, would enable day and night shifts to be worked, and would hus solve this problem.

According to recent reports from Australia a central station plant has just been completed at New Castle, which operates the Westinghouse system of alternating current central station apparatus. The installation comprises arc and incandescent lamps. The machinery for generating the electric current is driven by Westinghouse compound engines. The plant is composed of Westinghouse alternating current dynamos and exciters. Steam for the electric plant is generated by Babcock & Wilcox boilers. The switch board controlling the lighting arrangements is the most perfect and complete in the Australian colony. The street lights are worked on two independent circuits and there are also two independent circuits for private lighting. The exciters and dynamos for the plant were manufactured by the Westinghouse Electric & Manufacturing company at Pittsburgh, Pa. The installation of the apparatus was superintended by an engineer of that company who had been sent purposely to Australia. The Australian *Mining Standard* of February 14th, says: "The public and council of New Castle are more than pleased with the success of this installation. The plant has now been running for six weeks and no break has occurred, since the moment the lights were first turned on. In the adoption of the electric light the town of New Castle has provided another example of its enterprise and progressive spirit. The advent of the electric light created some little commotion at first. but the fiat has gone forth and now a mild outburst of jubilation testifies to the installation of electric light as a great public convenience."

ELECTRIC MOTOR.

One of the features of the grand parade in Des Moines during the Iowa state fair was an electrically propelled buggy, the current being furnished by storage batteries.

It is reported that a system of electric cabs has been introduced in Stuttgart, Germany, with a degree of success that promises the permanent relegation of the cab horse to other fields of usefulness. The new vehicles are popular.

The greater economy of electricity over water power for elevators is shown in the following comparison: The duplex steam pump uses eight pounds per hour for each horse power, the engine which drives the dynamo to furnish electricity uses at most, four pounds. Only one-fifth of the power developed in the steam pump is utilized in lifting passengers. By the electric motor three quarters of all the power which is developed in the driving engine is used for operating the elevator; besides, in all large buildings there are electric lights, and electricity is used for various purposes, and there is likely to be an electric generator in any event. As to the question of safety, with all these various types of elevators, leaving out the water balance, there is practically no difference. The safety appliances which are on one machine may be applied to any or to all.

ELECTRIC RAILWAYS.

The Barnwell, S. C., Electric & Power company has been incorporated.

At Wilmington, N. C., an electric power plant will be erected to operate a street railway.

J. C. Henry of San Diego, Cal., has sold his electric railroad patents to the Anglo-American Electric company of New York.

The tracks of the Oakland, Cal., and Berkeely street railway have been completed and the wires are up. It is expected that the system will be operated in about a week.

The North Avenue Railway company of Baltimore, Md, will undoubtedly extend its electric railroad to the center of the city, using an elevated roadway for part of the route.

D. B. Cooper, C. H. Whitworth, P. P. Pickard and others of Nashville, Tenn, have chartered a company to build an electric railroad, and applied to the city council for a franchise.

The New Albany, Ind., Light, Heat and Power company will soon have completed its plant sufficiently to illuminate the stores in the business portion of the city with incandescent lights

A Sydney postoffice clock emits an electric flash-light, lasting five seconds, every hour during the night, thus enabling those living miles away, or traveling within a certain radius, to ascertain the exact time.

The Consolidated City Line of Kansas City, Mo., an electric railway connecting the two sides of the city, made its trial trip March 2. It was in every way successful. The trip was made under direction of the Thomson-Houston Electric company's representatives. This company furnished all of the electrical equipment of the new road. It connects with the great elevated system and the Grand View line, and passes the doors of many great manufacturing plants employing thousands of men, who gladly avail themselves of the cheap and rapid transit afforded by the new electric line.

The Short Electric Railway company has recently closed contracts with the Lincoln Street Railway company, Lincoln, Neb, for twenty car equipments and forty standard motors. A large number of the new gearless motors will be placed on the Lincoln lines when this order is filled. The company has also closed a contract with the West End Street Railway company of Rockford, Ill., for about five miles of overhead construction, three car equipments, six standard motors and an 80-horse power generator. The Short company has just received its third order from the S. Covington & Cincinnati Street Railway company. This covers two more 125-horse power generators, sixteen standard motors and three car equipments.

It is expected that the electric cars of the Davenport, Rock Island & Moline Electric Railway will be running on the Rock Island side of the river within three weeks. There is now in the power house in Rock Island enough machinery to operate a portion of the system, and the company is only waiting for the completion of one of the three big tripod boilers that are to furnish steam for the engines. This boiler will be set up and in order in a few days. The work of erecting the poles and stretching the wires on the Third avenue line in Moline is progressing and will be completed in about ten days. The car shop in Davenport, on the corner of Second and Rock Island streets, is under roof, and its inside work will be finished in two weeks, when it will be ready for occupancy. The Davenport *Democrat* says: "There are obstacles in the way of getting the cars in motion over here, however, and we shall not ride behind the motorneer as soon as our friends in Illinois. The hitch now is in connection with the crossing of the bridge with the lines. The plans for this work have been made for some time, have been submitted to the Western Union telegraph company and accepted as being satisfactory, and now all that is wanted is the order from the war department allowing the work to be carried out as contemplated by these plans. This order, for some mysterious, red tape reason, does not come, and in the meantime things are standing still. It will take some time to put the line across the bridge after the official permission is received. The representatives of the syndicate are not committing themselves to positive promises as to the day and hour the lines on this side of the river will begin to run by electricity, but they continue to hope that it will not be long, and our people join with them in the hope." The system is equipped with Thomson-Houston apparatus.

ELECTRIC MINING.

The Shawmut Coal company of Pennsylvania has the strongest faith in the use of electric mining machinery and believes that it is the power that will be used in the near future in all large mines, as it is more economical and more easily handled than compressed air. The company is using the new Lechner coal mining machine, and says it is a complete success. One generator and four motors are employed.

The mines belonging to the Anaconda company, the greatest copper producer in the world, have been shut down. This was caused by a disagreement with the Mortana Union railway, which hauls ore from Butte to the smelters at Anaconda. The railway wanted to advance rates about one-third, and the company refused to yield. The shut down will throw about 3,000 men out of employment. This may result in an advance in the copper market.

An Eastern mining paper recently made the statement that the Thomson-VanDepoele Mining company was not yet ready for business. This is certainly a mistake, as the Western power and mining department of the Thomson-Houston Electric company of Chicago is ready to take contracts for any class of electric mining machinery and is able to refer to plants already installed. This department has lately been organized with Lieut. F. B. Badt as manager, and the business has already grown to very handsome proportions.

NEW INCORPORATIONS.

Standard Light company of New Jersey, Elizabeth, N. J.; capital stock, $20,000; the manufacture and sale of electric light and power apparatus, electric lamps and other translators and generators.

The Bala and Merion Electric company, Bala, Pa.; capital stock, $28,000; supplying light, heat and power by electricity to the public in the township of lower Merion.

The Iron Mountain company of Michigan, New York City, N. Y.; capital stock, $1,000; owning and holding real and personal estate in the states of Michigan and Wisconsin, developing the same, operating iron furnaces, electrical railways and other manufacturing plants.

Ice, Light and Water company, Terrell, Texas; capital stock, $50,000; electric light business, also manufacture of ice; also to supply water to the public.

The Corporate Town company of Knoxville, Tenn, has been organized with a capital of $10,000,000. It proposes to own street railroads, gas works, furnaces, electric light and telephone plants, homes for artisans, and establish a manufacturing city in the healthier highlands of East Tennessee, which are so wealthy in timber, minerals and agricultural lands. The president is Superintendent of Census Robert P. Porter, and associated with him in the directory are ex-Congressman McComas of Maryland, who is vice-president, and United States Senators John G. Carlisle of Kentucky, Isham G. Harris of Tennessee, H. C. Hansbrough of North Dakota, ex-Representative Butterworth of Ohio, Augustin Davis of Chicago, Judge Love and W. P. Love of Tennessee, S. M. Johnson of Knoxville, and B. A. Jenkins, president of the National Bank of Knoxville, who is the treasurer of the company.

TELEGRAPH.

An ordinance will probably be introduced in the city council of Baltimore to appropriate $50,000 for the purpose of laying underground the wires of the police and fire alarm telegraph.

A cable to connect Spain and Morocco is being laid. The sections from Almeria to the island of Alboran and from the latter place to Melilla, on the African coast, have already been put down.

TELEPHONE.

The directors of the Erie Telegraph & Telephone company, it is reported, have under consideration a proposition to sell a portion of their 70 per cent. interest in the stock of the Southwestern Telegraph & Telephone company for $700,000, which is equivalent to $50 per share for Erie stock.

Referring to the telephone lines between Paris and London an English exchange says: There are 80 miles of land line to Dover, and 180 from Paris to Sandgate, where the French shore end lands. The cable itself has four thick copper wires, two of which will be used at first, and the other two, if found necessary, afterward. The total cost is estimated as about $400,000. At first four call boxes will be connected, and the governments look to Stock Exchange interest to recoup them for their trouble, A West end branch will be opened in London, and means will be taken to enable private wires to be connected. The line can be used for telegraphic purposes in the night-time if not otherwise required. The land line to Dover is taken on a new set of posts carrying double cables, a complete metallic circuit, two wires to the cable crossed continually to obviate induction. Mr. Preece says that the speaking on the land line is perfect, better than any London circuit, and as good as from one room to another in the post-office.

MISCELLANEOUS.

An exchange says: New York state has the only legislature criminally stupid enough to drive capital out of its own borders. Other states have abundance of state pride and state selfishness, but New York, city or state, from a consciousness of its pre-eminence or from public apathy which brings about the election of unfit representatives, continues to legislate against itself. President Coleman of the tax department is quoted as saying that he is prepared to show to any one who wishes to see it, at his office, an itemized list of corporations, aggregating $450 000,000 of capital, which have been forced out of New York, and have reorganized in the two counties of Hudson and Essex, across the river in New Jersey, during the period from January 1, 1890 to January 20, 1891. This list he will present shortly either to the city authorities or to the committee on taxation of the legislature, at Albany, for their consideration. This only includes two counties in New Jersey and does not include Connecticut or other migration. The list contains the most prominent electrical concerns with headquarters in New York.

TRADE NEWS.

"K. K." wire still continues in active demand, and the Great Western Electric Supply company of Chicago reports a phenomenal sale for the last month.

George Cutter of Chicago has lately received two carloads of Simplex wire, including an assortment of the extra heavy insulation suited for use in mines. This has been used largely in the iron mines in Northern Michigan and has given satisfaction even under the severe conditions which are met there. Many large duplicate orders have been received.

The Central Electric company, Chicago, has just issued an illustrated catalogue covering the entire supply business. The several departments are arranged and classified and an index is furnished. A feature of the catalogue and one that will be greatly appreciated is the telegraph code which is given. The catalogue is handsomely illustrated and contains much useful information.

The Bain Electric Manufacturing company, Chicago, has just issued a new catalogue which is worthy of special mention. That the little pamphlet was compiled by a practical man is evident at a glance. The pages in the fore part of the book are filled with cuts and reading matter descriptive of electric light and power apparatus designed by Foree Bain, and the remainder of the space is filled with electrical data which will be most valuable to men who want practical hints expressed in a concise and thorough manner.

Miliken Bros., New York, report a large demand for their street railway and electric light poles, which they are now furnishing to almost every section of the United States and Canada. They have their large shops now equipped with special machinery for turning out this class of work, and are able to fill orders promptly, either from stock on hand or at short notice. Among the recent orders which they have secured are the iron poles to be used for all the street railway work at Pittsfield, Mass. The street on which these poles are to be used is unusually wide, and consequently the strain on the poles will be very great. This firm has issued a very handsomely illustrated catalogue showing the different forms of poles which they make, and their advantages Information regarding poles for

street railway or electric light work will be cheerfully furnished.

Frank X. Cicott, who for several years has been manager of the San Francisco branch of the Holmes, Booth & Hayden company, has been engaged by the Electric Merchandise company, Chicago, as manager of its rail department. Mr. Cicott has studied the street railway business in this country and abroad and is well fitted to handle the Tramway Rail company's product for its selling agent, the Merchandise company. General Manager Mason reports the closing of several large contracts for rails, and states that the prospect for good business in this particular line appears to be unusually bright

The Knapp Electrical Works, Chicago, is introducing a new insulating torch, which consists of a thick paper tube one foot in length and one inch in diameter, supplied with a handle at one end, and filled with a high grade of insulating compound.

In using the torch, it is necessary to ignite the paper which will burn just fast enough to keep the compound at the right temperature for use. When the joint has been covered, the torch is blown out and there is no waste of compound. Being supplied with a handle, it can be entirely used up. It is also much cleaner to handle, and the necessity of using a fire pot or gasoline torch to heat the compound, is entirely obviated.

BUSINESS.

The Triumph Engine, manufactured by the Triumph Compound Engine company, of Cincinnati, Ohio, is specified in several large contracts, shortly to be let in Chicago.

The Cowles Electric Smelting & Aluminum Company announces that it has removed its office to Lockport, N. Y. It believes this will aid in facilitating the business, as correspondence and orders can have more prompt attention.

C. M. Turnquist, 2965 Cottage Grove avenue, Chicago, announces that he has a full line of burglar alarms, annunciators, electric bells, alarm clocks, watchman's clocks and other electric supplies. Mr. Turnquist is ready to engage in all kinds of experimental work.

The Electric Railway Specialty company of New York has received orders for extensions of the East Reading road at Reading, Pa. A large number of wooden tooth gears have been ordered. There is a large demand for the company's Perfection grease cup.

The Northwestern Electrical Specialty company, 1017 Chamber of Commerce building, Chicago, announces that it has secured the general Western agency for the Economic incandescent lamp. Although this lamp has been on the market but six months, the sales are placed at 35,000.

The new catalogue of the Partrick & Carter company of Philadelphia forms a compact volume of 176 pages. It contains a valuable list of the electrical supplies manufactured by this reliable house. Especial attention is called to the new King bells supplied by this company. In this bell only the gong is exposed.

The Illinois Electric Material company, Chicago, has removed to 158 Fifth Avenue, where it has opened a store on the ground floor. The company will engage in a retail business in the electric light and railway supply line and keep a stock of Bishop India rubber wires and Canvas Jacket patent woven moisture-proof wire as well as minor supplies.

The Great Western Electric Supply company of Chicago is putting upon the market two arc lamps, one for incandescent and the other for arc circuits. It is said that these lamps can be operated by either the direct or the alternating system. They will be sold at a low price. This company reports that it is having great difficulty in keeping pace with its lamp orders, but, with increased facilities, it is now able to fill orders promptly.

The Chicago Incandescent Light company, 13 and 17 North Jefferson street, is fitting up a very complete establishment for the manufacture of the Schaefer incandescent lamp. This company was formerly at 75 North Clinton street, but finding the quarters altogether too small was compelled to seek a new location. The very best machinery is being put in place, and in a few days the plant will be in full operation, turning out upward of 1,000 lamps.

Jas. McLaughlin, 48 to 52 N. Clinton street, Chicago, is meeting with marked success in the repair of street car armatures and in the intelligent handling of any heavy repair work intrusted to his care. Mr. McLaughlin is one of the men who have been engaged in electric business almost since its inception. He personally inspects every piece of work before it leaves his workshop. He is using a new copper and aluminum alloy for commutator strips that is giving satisfaction,

The Jenney Motor company of Indianapolis has just issued a new price list that marks a very material reduction in the cost of the company's apparatus. and with the establishment of new agencies in New York, Boston, Philadelphia and other large cities, which has just been consummated, a very large business for the approaching season is anticipated. This company has just perfected a new plating dynamo of 5,000 watt capacity, which it is offering to the trade. Extensive new buildings are being erected and the outlook is most flattering,

Two of the large twelve-inch belts of the Page Belting company of Concord, N. H., have been running in one establishment in Philadelphia day and night for a year at a speed of 5,761 feet per minute, thus demonstrating their adaptability to high speed work. The catalogue of this company, containing "Practical Rules for the Purchase and Use of Belting," is out for 1891, and will be sent to any address. Among other specialties which are manufactured by this company are dynamo double belts. These are double leather belts of great excellence and made with the best of care and from the best of material. A neat circular has just been issued by this company describing this class of goods.

The following statement is authorized by the Westinghouse Machine company:

For several months past the daily press has constantly referred to what it called the financial troubles of the Westinghouse interests. While it is true that there are several industrial corporations which in one form or another bear the name of "Westinghouse," it is equally true that the "financial troubles" among these companies have been confined to what is known as The Westinghouse Electric & Manufacturing company, or, in other words, to that company whose business consists in making and vending electrical apparatus. The Westinghouse Machine company, for instance, whose business consists in making and selling Westinghouse engines, has had no financial trouble. Instead of curtailing its operations, this establishment is still further increasing its capacity as rapidly and as much as it can. New tool and store rooms are just approaching completion, and it is hoped by the management, during the coming spring or summer, to be able to add new erecting and testing shops fitted with large power cranes and all modern improvements, and having a producing capacity twice as great as the present ones.

ELECTRICAL PATENTS.

Issued March 24 1891.

448,627. Telephonic Auditory Apparatus. George V Benjamin, Ithaca, N. Y.

448,644. Electric Converter. Moses G. Farmer, Eliot, Me.

448,653. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

The last claim follows:

"9. A slotted conduit, in combination with a sectional conductor located therein, switches to connect said sections in series, a car, an electric motor on said car, current-collecting devices carried by the car entering the conduit and making contact with the conductor, and switch operating devices carried by the current-collecting devices."

448,666. Dynamo-Electric Machine. Samuel E. Nutting, Chicago, Ill.

448,669. Electric Contact Device. Frank A. Perret, Brooklyn, N. Y.

448,676. Meter for Alternating Electric Currents. Oliver B. Shallenberger, Rochester, Pa.

448,677. Meter for Alternating Electric Currents. Oliver B. Shallenberger, Rochester, Pa.

The object of the invention is to provide means whereby a meter may be caused to register the current consumed in doing useful work and prevent it from being operated by leakage currents, or by such currents as may be consumed in any other operation than doing usefal work.

448,679. Water-proof Combined Coupling and Cut-out for Electric Circuits. Frank Shlaudeman, Decatur, Ill

448,680. Connector for Electric Wires. Frank Shlaudeman, Decatur, Ill.

448,681. Speed Regulator for Electric Motors. Sidney H. Short, Cleveland, Ohio.

This invention relates more particularly to the means for controlling the current of electricity supplied to the motors for propelling cars on electric railways, but the improvements constituting the same are included for all the uses to which they may severally be adapted.

448,682. Adjustable Rheostat. Sidney H. Short, Cleveland, Ohio

448,684. Fire Alarm Signal-Box. William F. Singer, Carthage, N. Y.

448,698. Electric Switch. Donlee B. Turner, Chicago, Ill.

448,703. Support for Electric Line-wires. Herbert C. Wirt, Boston, Mass.

448,711. Overhead Crossing Appliance for Electric Railways. Isaiah H. Farnham, Wellesley, Mass.

This invention relates to the electrical operation of railways, and comprises a peculiar arrangement of the frogs or crossing appliances associated with the contact devices which slide or roll upon or otherwise make contact with the supply line or lines of an electric traction system and which connect with an electric motor placed upon the vehicle which is to be moved.

448,712. Electric Time Alarm. John J. Gallagher, St. Louis, Mo

448,726. Telephone Transmitter. Thorstein Oeyan, Christiana, Norway.

Of the seven claims the first is given:

"In a phonic transmitter, a microphone casing and a holder therefor connected together so as to revolve about their axes and to alternately recede from and approach each other when one of said parts is continuously revolved in the same direction, or when both parts are continuously revolved in opposite directions.

448,741. Cover for Incandescent Lamps. Emil T. Mueller, La Crosse, Wis.

448,743. Electric Heater for Dental Vulcanizers. Jeremiah O'Meara, New York, N. Y.

448,751. Railway Circuit for Signaling and Controlling Trains. Frank E. Kinsman, Plainfield, N. J.

The invention relates to combinations of circuits and apparatus for use in connection with railways, for the purpose of controlling or operating signals, switches, brakes, or other devices employed in signaling to trains and controlling the movement thereof in any manner.

448,778. Electric Railway. Thomas A. Edison, Menlo Park, N. J.

448,779. Telegraph. Thomas A. Edison, Llewellyn Park, N. J.

Claim one is:

"The combination, with two or more telegraph lines, each having ordinary Morse sets and induction sets of one or more induction connections between such lines and one or more retarding or damming magnets to divert the induction signals from portion of such lines.

448,782. Electric Lighting. Rudolph M. Hunter, Philadelphia, Pa.

448,786. Brace for Telegraph Poles. Henry Ogden, Fall River, Mass.

448,792. Electrical Indicator. Charles Wirt, New York, N. Y.

448,798. Galvanic Battery. Charles J. Hirlimann, Fort Lee, N. J.

The object of the invention is to provide a battery which will generate nearly its full current immediately after it is mounted, and also to provide a battery cell in which the cover may be quickly put into place, and when once fixed will not become easily detached by rough handling.

448,831. Trolley for Electric Railways. Rudolph Eickemeyer, Yonkers N. Y.

448,838. Insulator for Electrical Conductors for Mines. Francis A. Pocock, Scranton, Pa

448,840. Protecting Motor Mechanism of Electric Cars. Sidney H. Short, Cleveland, O.

448,847. Clamp for Electric Battery Zincs. James H. Leakin, Baltimore, Md.

448,856. Electric Signaling Apparatus for Railways. Edwin D. Graff, New York, N. Y.

448,865. Lamp for Electric Railway Cars. Charles G. Smith, Brooklyn, N. Y., and Louis Pfingst, Boston, Mass.

448,879. Electric Heating Apparatus. Mark W. Dewey, Syracuse, N. Y.

448,894. Electric Meter. Elihu Thomson, Swampscot, Mass.

448,910. Electric Street Car Driving Gear. Conrad M. Conradson, Madison, Wis.

448,914 Filament for Incandescent Electric Lamps. Georg Erlwein and Frederich G. A. Heller, Berlin, Germany.

448,915. Filament for Incandescent Electric Lamps. Georg Erlwein, Berlin, Germany.

448,916. Filament for Incandescent Electric Lamps. Georg Erlwein, Berlin, Germany.

448,920. Filament for Incandescent Electric Lamps. Friedrich G. A. Heller, Berlin, Germany.

448,927. Locomotive Engine. Ralph Peacock and Hermann L. Lange, Manchester, England

448,936. Electrolyte for Galvanic Batteries. John J. Collins, Washington, D. C.

448,953. Electric Belt. Willie C. Fuller, Kirwin, Kan.

448,956. Electric Insulator. George H. Graham, Ridgeland, and Thomas Gannane, Chicago, Ill.

448,963. Railway Alarm Signal. John R. Jones and John W. Scott, Arlington, Ill.

448,980. Electrical Protector. Isaac N. Miller, Cincinnati, Ohio.

448,994. Matrixmaking Machine. Casper L. Redfield, Chicago, Ill.

448,998. Independent Electric Clock. William S. Scales, Everett, Mass.

448,999. Secondary Electric Clock. William S. Scales, Everett, Mass.

449,001. Method of Measuring Alternating Electric Currents. Oliver B Shallenberger, Rochester, Pa.

The invention consists in so organizing a meter designed to be connected in the primary or supply circuit or to measure the current flowing through it, that it will commence to operate only when the flow of current through the circuit to which it is applied exceeds the leakage of the circuit, or of the converters connected in the circuit, and at the same time will give an accurate record of all the current consumed in doing useful work.

449,002 Meter for Alternating Electric Currents. Oliver B. Shallenberger, Rochester. Pa.

449,003. Meter for Alternating Electric Currents. Oliver B. Shallenberger, Rochester. Pa.

Claim four reads:

"4. In an electric meter, the combinations, with the armature, its including coils, and the projection or brake normally pressing against the surface of the armature, of the core, acted upon by the currents flowing to the meter and brought into operation by currents of a predetermined value to release the armature from the detent."

449,035. Electrical Heater. John V. Capek, New York, N. Y.

449,036. Electrical Heater. John V. Capek, New York, N. Y.

449,044. Electric Lighting System. Edward H. Johnson, New York, N. Y.

449,081. Electric Time Stamp. Warren B. Martindale, Kenosha, Wis, and Ernst R. Malmborg, St. Louis, Mo.

449,090. Electric Rock Drill. William M. Schlesinger, Philadelphia, Pa.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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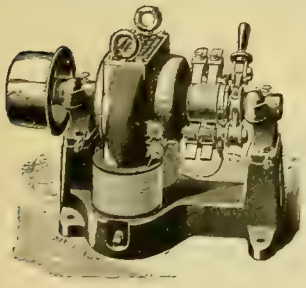

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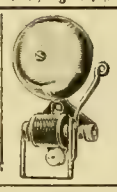

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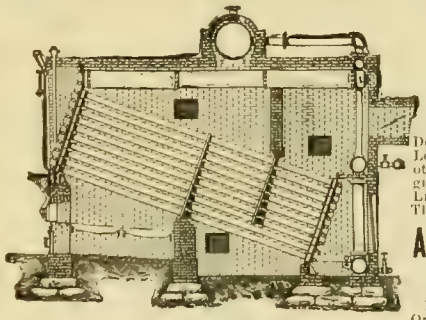

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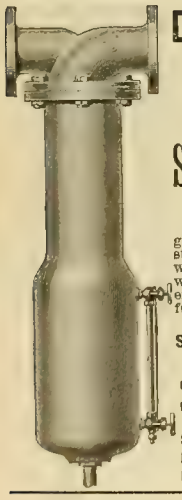

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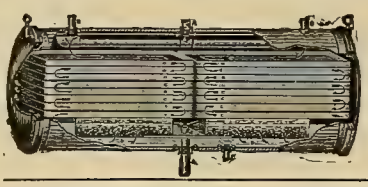

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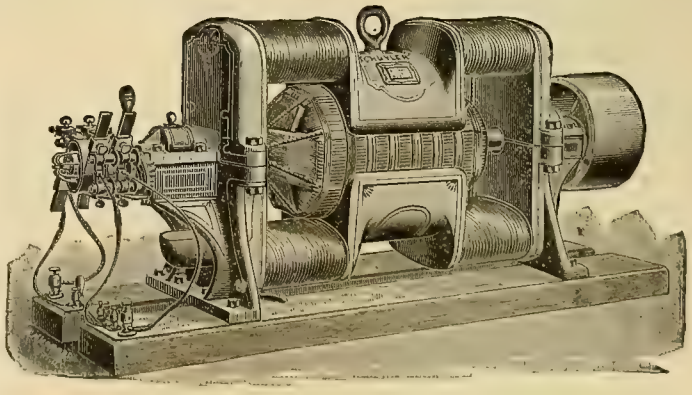

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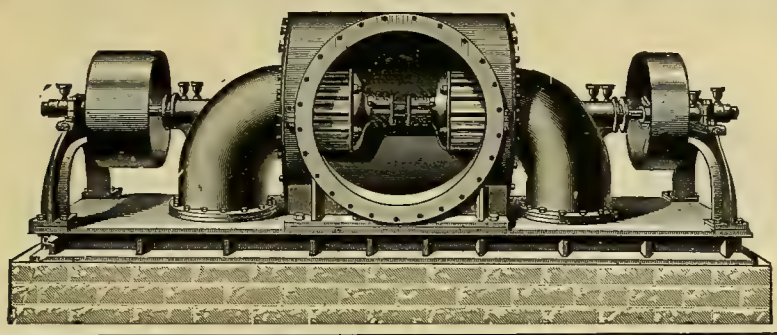

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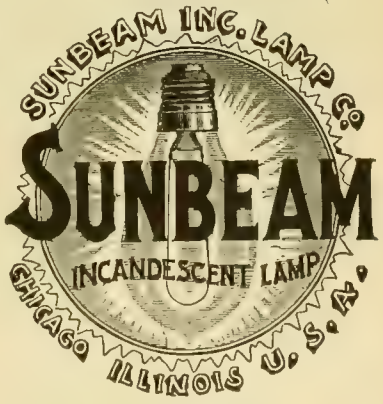

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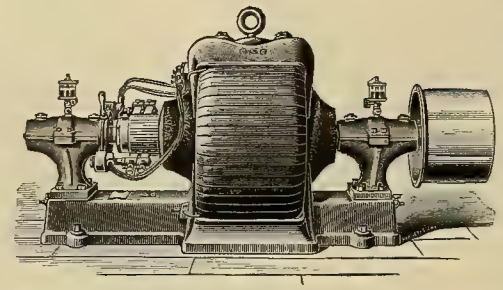

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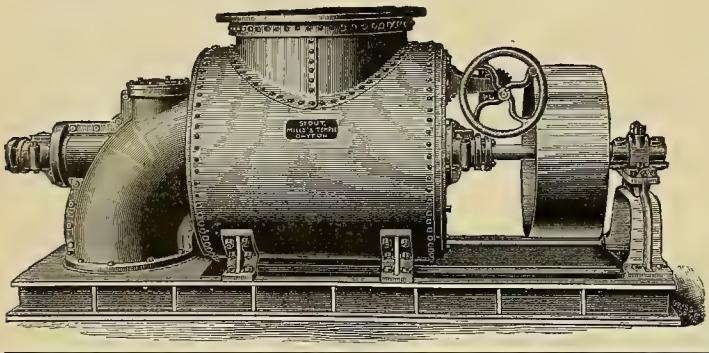

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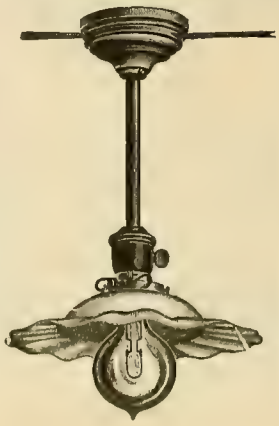

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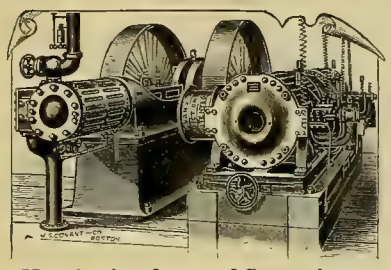

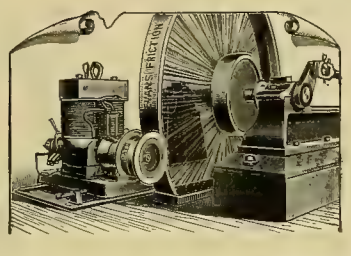

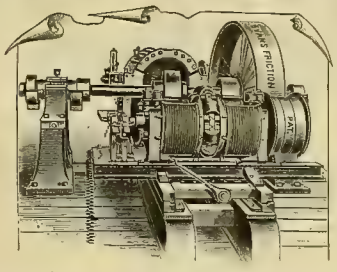

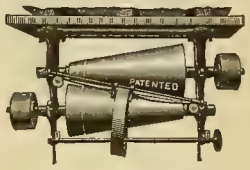

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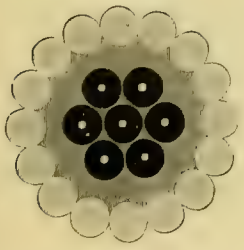

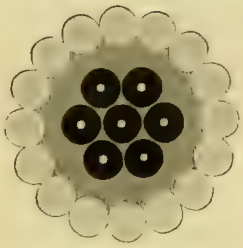

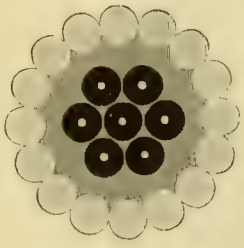

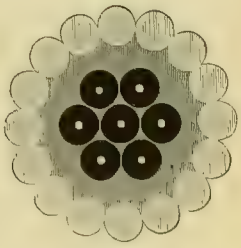

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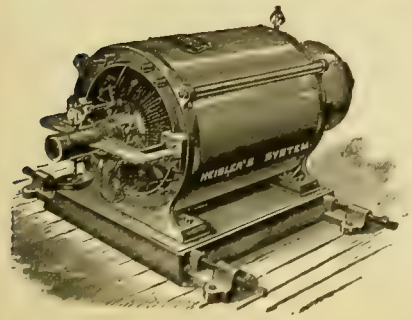

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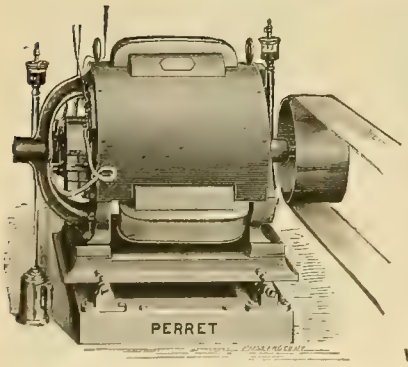

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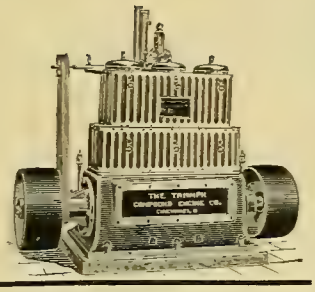

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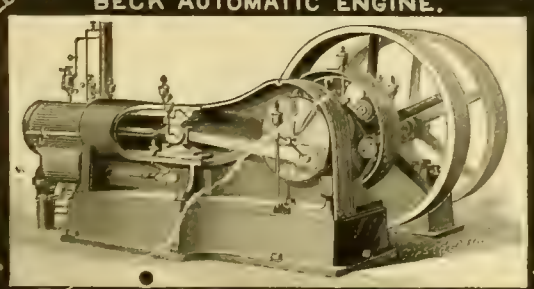

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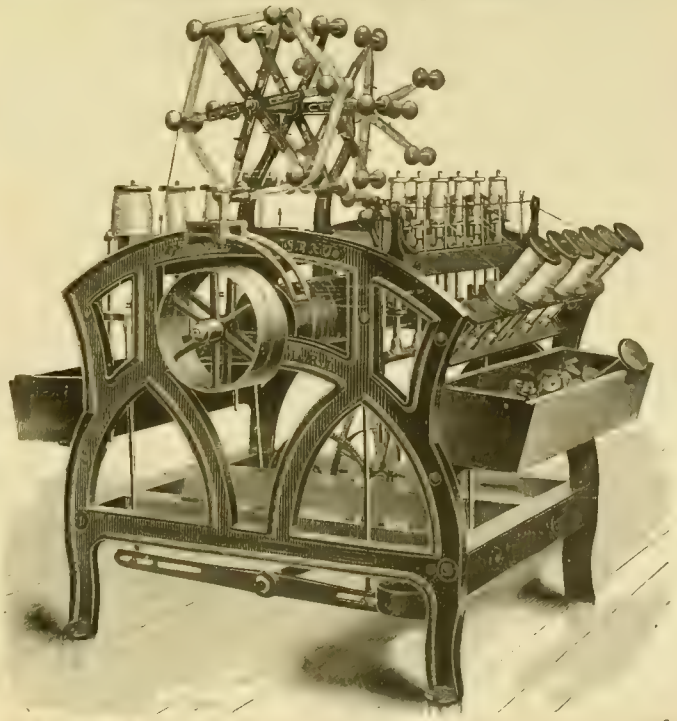

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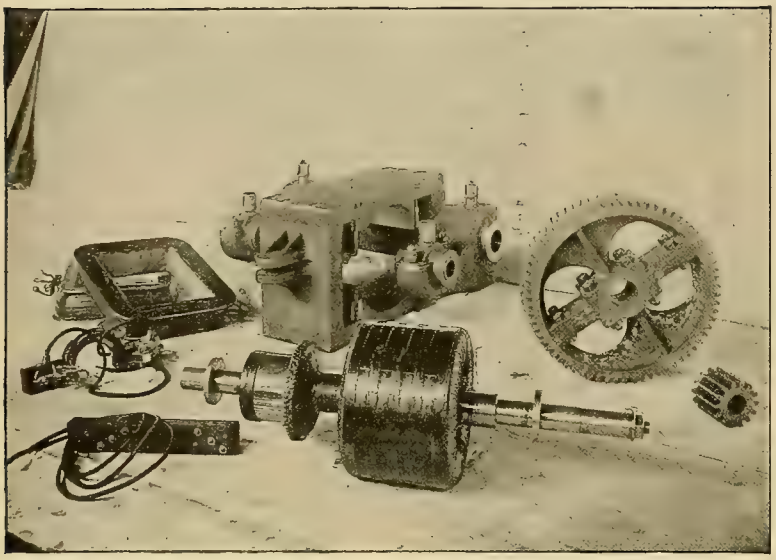

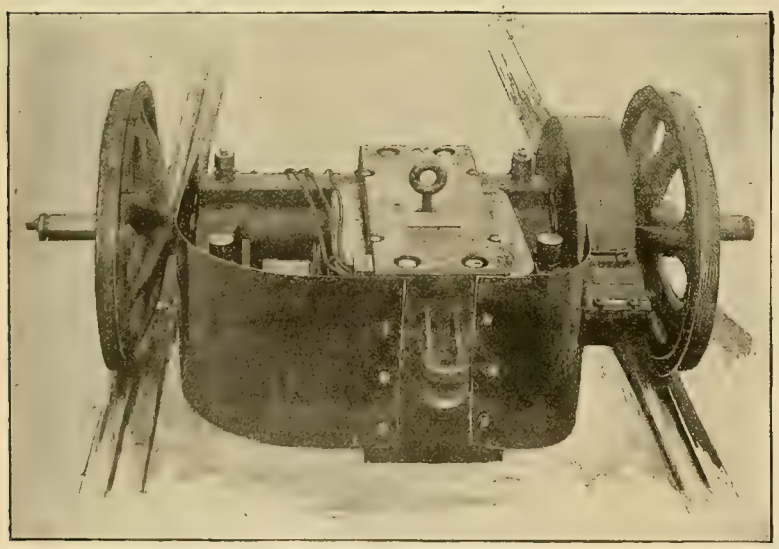

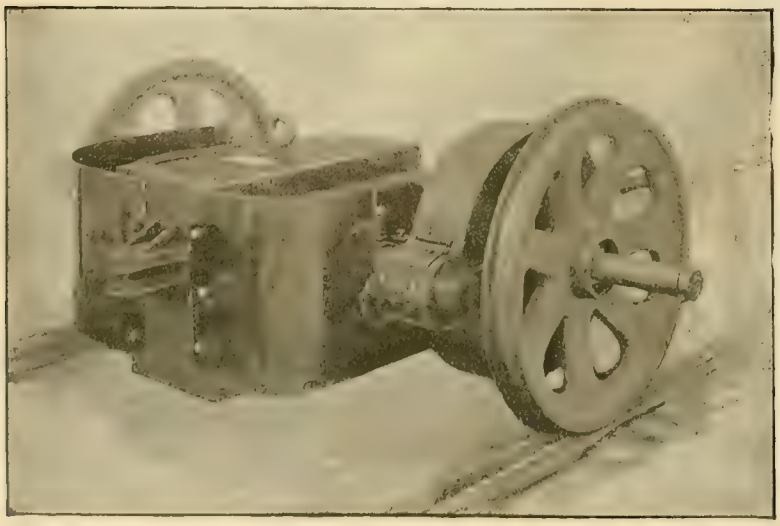

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Piqua, Ohio. Dec 9 1890

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Piqua Electric Light and Power Co.
BY H. B. Brooks Supt.

W. R. Dawson, President J. V. Gatard Vice Prest. Geo. S. Dawson, Sec & Treas.

Ottumwa Railway, Electric & Steam Co

105 South Market Street

Ottumwa, Iowa, Dec 9th 1890

The Electrical Supply Co.
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Yours of 8th inst at hand also yours of 2d was duly rec'd. It was entirely unnecessary for you to call our attention to the strong points of the Shield brand wire as we have put up over 30 miles of Electric Light lines this season using your Shield brand wire throughout and we are satisfied that we made no mistake in selecting your wire for this work. We are not in need of any line wire at present

Respectfully
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Electrical Accumulator Company vs. Julien Electric Company, 38 Federal Reporter, 117.
Brush Electric Company vs. Julien Electric Company, 41 Federal Reporter, 679.

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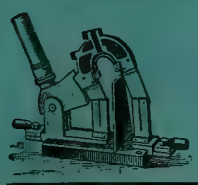
Vol. VIII. CHICAGO, APRIL 11, 1891. No. 15

"AJAX SWITCHES"



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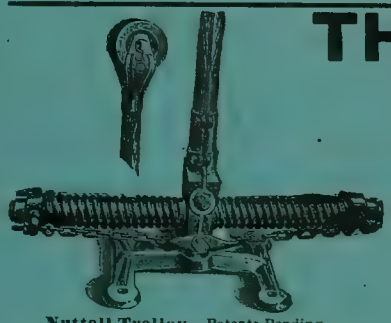

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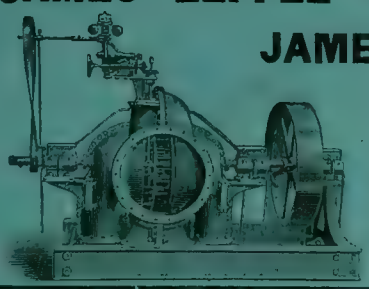

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PAGE XXVI.

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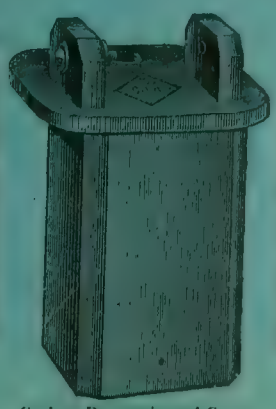

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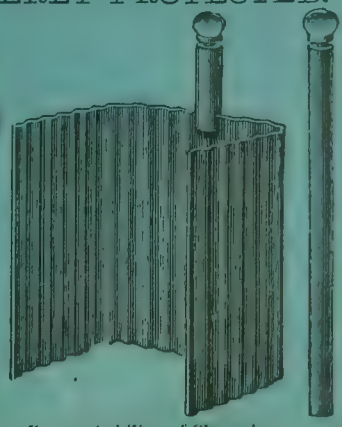

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4,100	NORTH DAKOTA,	375
3,100	NORTH CAROLINA,	1,183
15,555	TOTAL,	1,703

NINE TIMES as many of the Thomson-Houston System as of

ALL OTHERS COMBINED.

The figures referring to "total of all systems," taken from table published in August number of "Electrical Industries," for year 1890, are of undisputed accuracy.	Total of all systems.	Thomson-Houston System.	
		Number.	Percentage to total of all systems.
Montana, - - - -	8,500	8,355	$98\frac{3}{10}$ per cent.
North Dakota, - - -	4,475	4,100	$91\frac{3}{5}$ per cent.
North Carolina, - -	4,283	3,100	$72\frac{3}{10}$ per cent.

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215 West Fourth Street, Cincinnati, O.
1110 Noble Street, Philadelphia, Pa.
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115 North 3d Street, St. Louis, Mo.

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Bells, Magneto.
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Stanley & Hall.
Star Electrix Co.
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Evans Friction Cone Co.
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Great Western Electric Supply Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Paiste, H. T.
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Southern Electrical Supply Co.
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Central Electric Co.
Electrical Supply Co., The.
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Greeley & Co., The E. S.
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Detroit Electrical Works.
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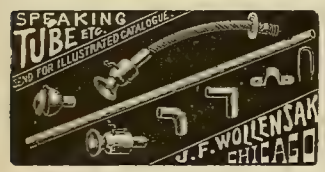

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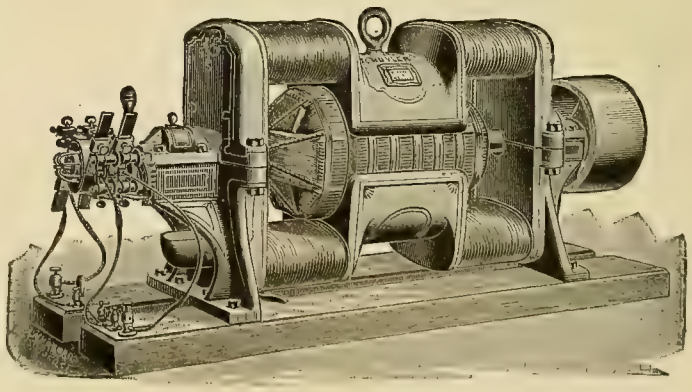

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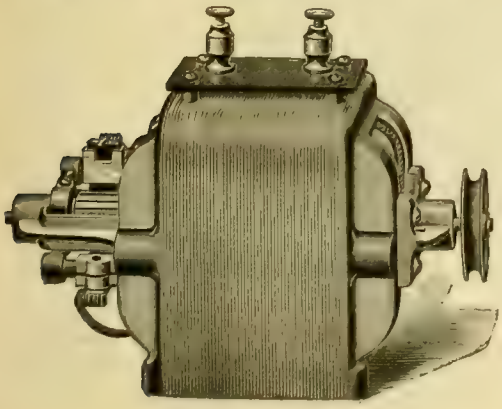

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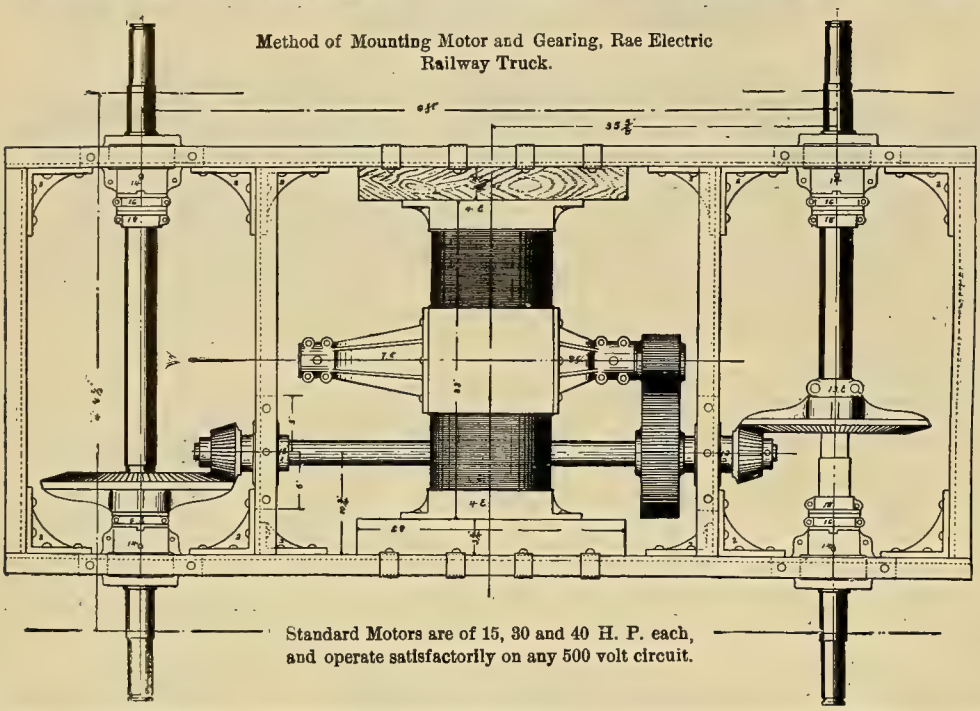

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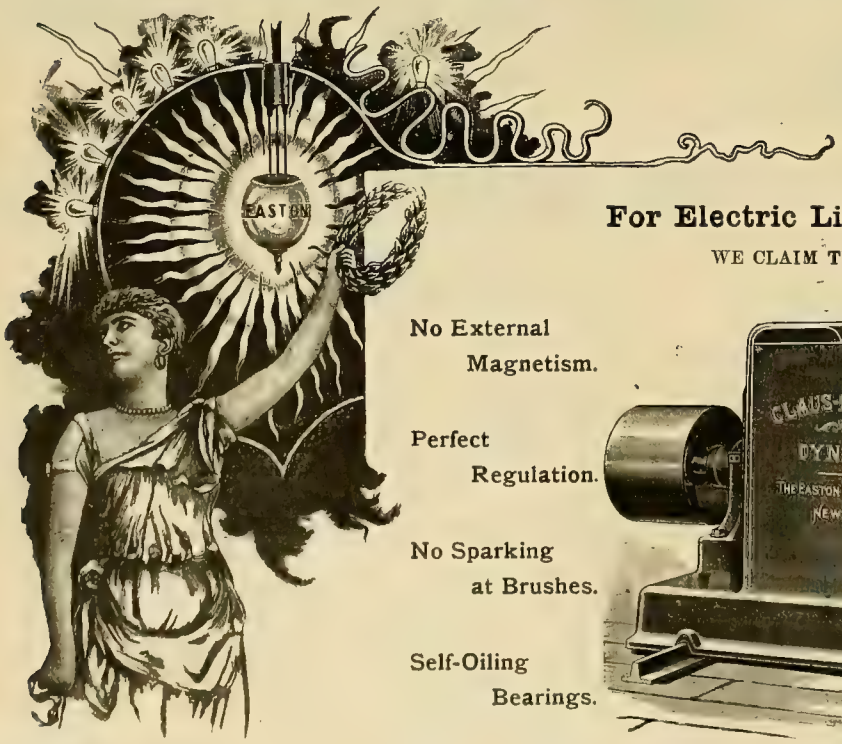

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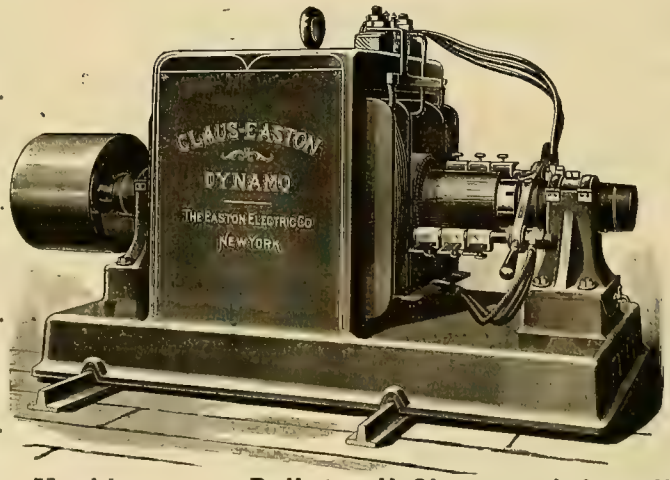

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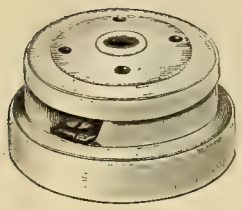

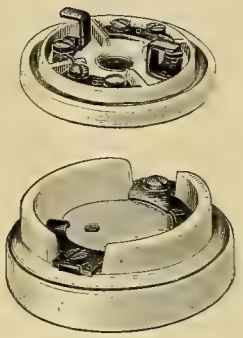

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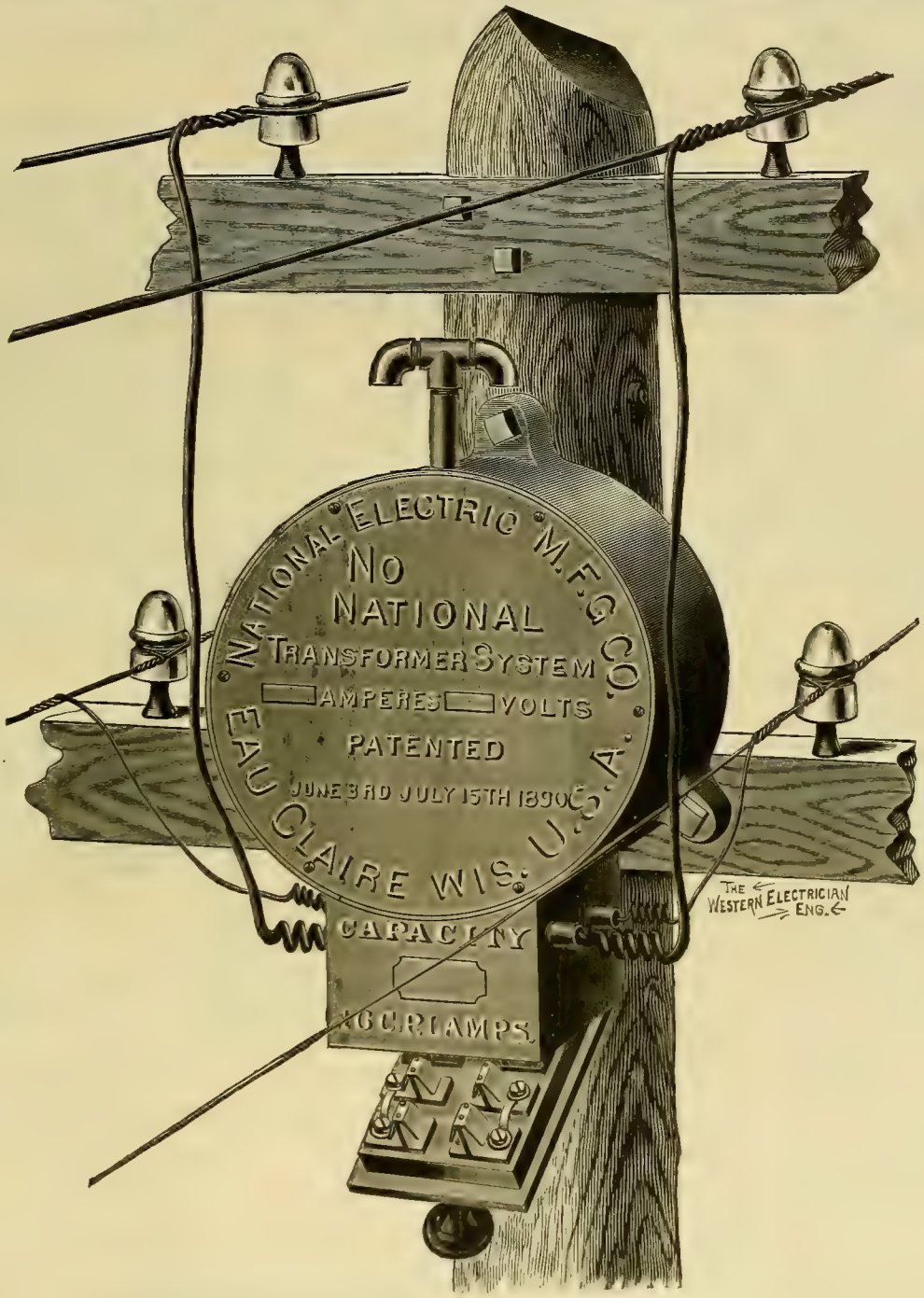

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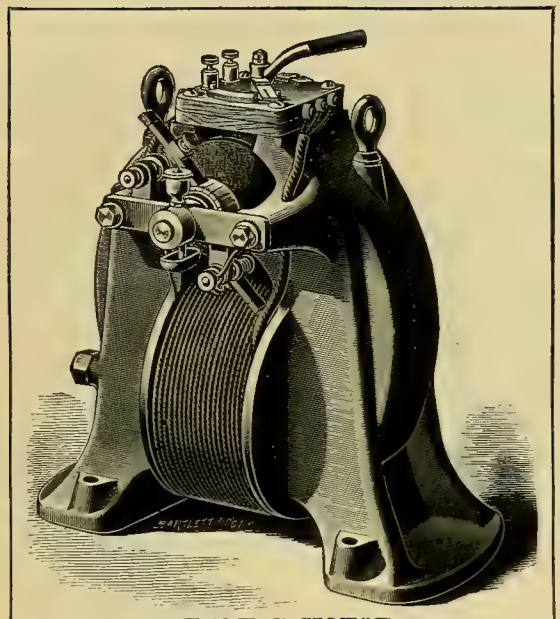

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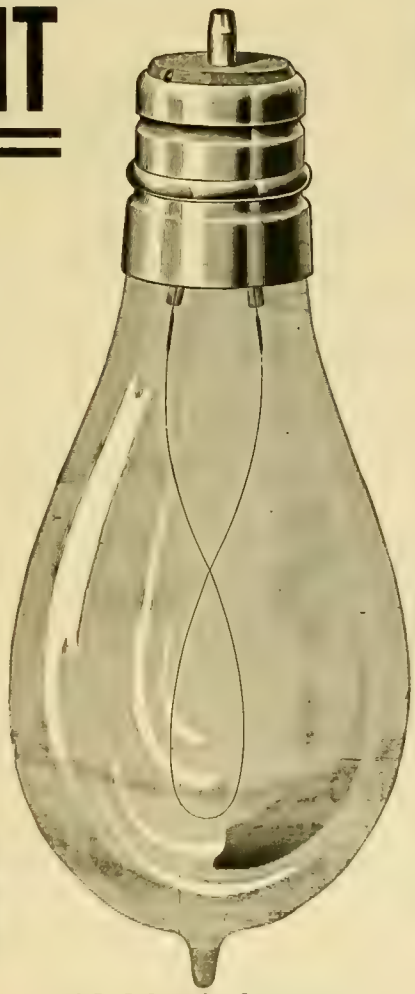

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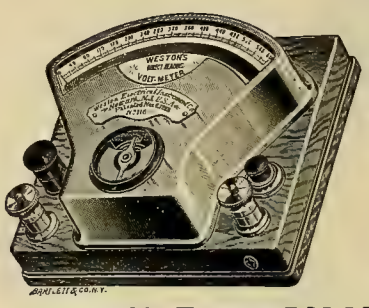

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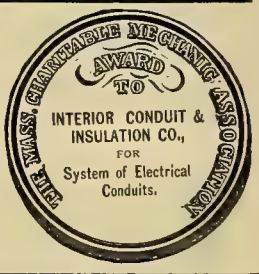

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EVERY SATURDAY.

Vol. VIII. CHICAGO, APRIL 11, 1891. No 15

Electrical Building, World's Fair.

The question of the location of the electrical building of the World's Fair continues to be the leading topic, not only in electrical circles, but also among the World's Fair officials. The general interest manifested by representatives of every branch of the industry, as shown in the interviews published in the WESTERN ELECTRICIAN last week, has forced the question upon the World's Fair officials. In the construction department the position of the electrical people caused considerable uneasiness. Chief Burnham realized that the electrical interests were determined to secure additional space, and, moreover, that they would be dissatisfied with any plans that did not contemplate a united exhibit. The question was thoroughly considered, but nothing definite was determined. Chief Burnham said the matter had been carefully investigated, and that it was still under consideration. On Saturday night he left Chicago for New York for the purpose of consulting the eastern architects on World's Fair business, and it is believed one of the subjects will be the question of providing a larger electrical building.

Strange though it may appear, it seems that the construction department has, up to the present time, given no attention whatever to the subject of former electrical displays. It appears that no data has been collected, and it has been taken for granted that provisions that were made in the original plans were on a far more extensive scale than anything attempted in this line before. When the statement was made, therefore, that the proposed building was smaller than those in which former exhibits were held, it proved a revelation to the construction department. The only reply that was offered was that the present plans provided for a larger display than that made at Paris, and that a comparison with former electrical expositions could not be fairly made as they were special displays, while the electrical department of the World's Fair would be only one of many departments. Mr. Burnham did not appear to be familiar with the advancement that had been made in the application of electricity, and therefore did not seem to realize the necessity for additional room.

Chief Barrett of the Department of Electricity called at the construction department last week for information concerning the proposed electrical building. The plans for this building are in the hands of Van Brunt & Howe of Kansas City, and are not yet completed. A blue print showing the location of the buildings at Jackson Park and the arrangement of the grounds was shown. A copy of this ground plan is given in Fig. 2 (page 202). An examination of this map satisfied Chief Barrett that the statements made by the WESTERN ELECTRICIAN were correct. The dimensions of the electrical building as proposed will be inadequate, and it will be impossible to enlarge the structure. After examining the plans Chief Barrett disapproved them, in fact he declared he would not under any consideration give his approval to those plans. As a solution to the problem he proposed to abandon the electrical building and take as a substitute the "Machinery annex." An addition could be made to the circular building, which could be used as a power house, and in this he proposed to mass all of the generating machines. Around this building it was proposed to construct a railway on which the several electrical systems could be displayed. The dimensions of this building, the proposed annex and the provision for the electric railway are shown in Fig. 1. This building would afford ample floor space for the electrical display, and would enable the electrical exhibits to be shown under one roof. It would provide for a magnificent and imposing display, and one in which the entire electrical fraternity would take special interest. Such a display would prove a great success, as it would enlist the best efforts of the entire fraternity. If, on the other hand, the electrical people lose interest in the exposition, as they certainly will if their wishes are entirely disregarded, the electrical display will prove a failure.

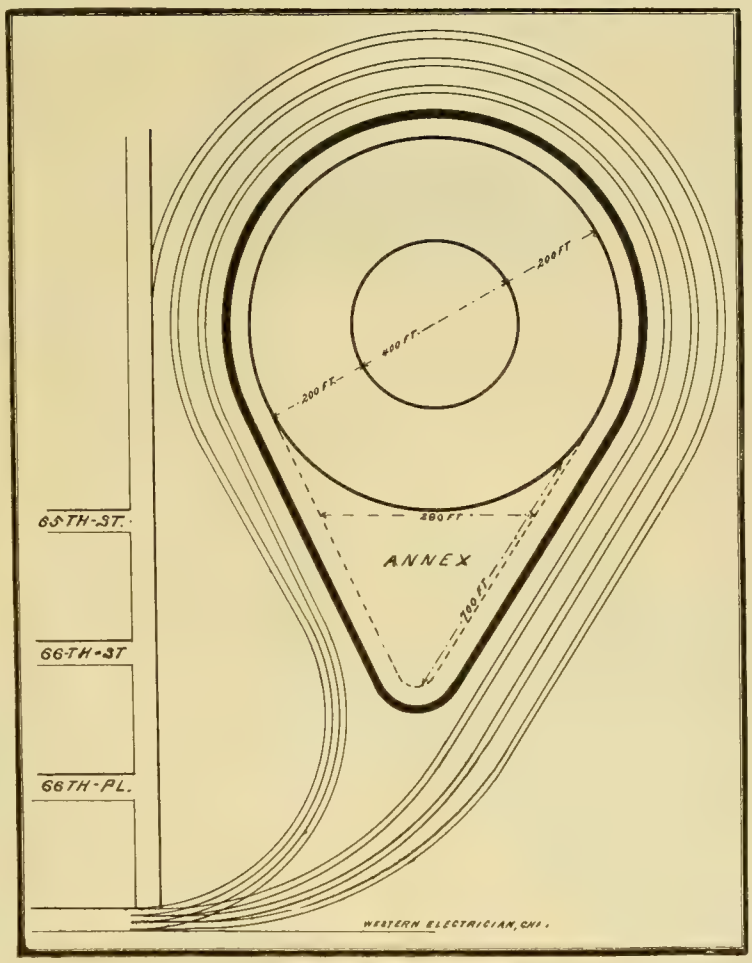


FIG. 1. ELECTRICAL BUILDING, WORLD'S FAIR.

Commenting upon an editorial in a former issue, the Rochester, N. Y., *Herald* says: "The WESTERN ELECTRICIAN says that the plans decided upon for the World's Fair 'will mean an electrical building only about two-thirds of the required dimensions' and a division of the electrical display, which will be very annoying and embarrassing to electricians and the public. That is unfortunate. The display of electrical apparatus and appliances must be one of the most fascinating exhibits of the fair, and the building devoted to them should be fully equal to the demand."

Electric Lights in Chicago Theaters.

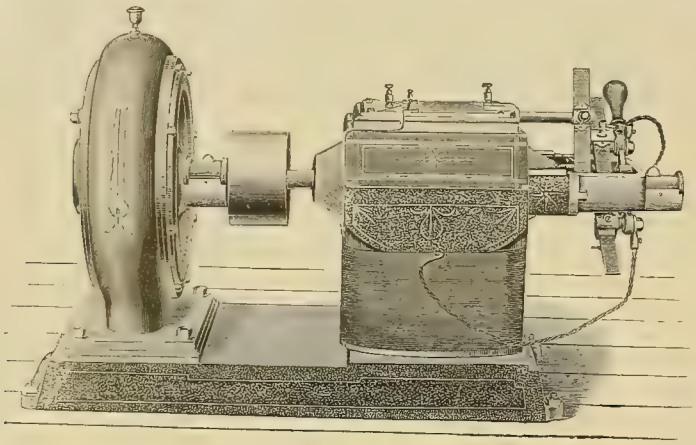
Chicago has long been noted for the enterprise displayed by its theatrical managers, but few people realize the exact position they hold in relation to the Eastern managers. It is claimed by those whose intimate association with all concerned, places them in a position to know, that the Chicago managers lead their eastern brothers. This is plainly shown in the attitude of managers of traveling companies. Those requiring special facilities for scenic effects, brilliant spectacular productions, etc., prefer Chicago to New York or Philadelphia. One of the most important announcements in this line was made by David Henderson in Chicago last week. He said he would not take this year's spectacular company to New York because there are no facilities in that city for a big spectacular production. Of course this announcement aroused the curiosity of the Chicago reporters, and one of them secured an interview with Manager Henderson, in which the latter said: "It is true that Chicago is far ahead of New York in the condition of its theaters. Think of it! There are only four theaters in the eastern metropolis that are lighted by electricity, the Broadway Theater, the Standard, the Metropolitan Opera House, and the Lyceum. The others stick to the use of gas, and a mighty poor quality of gas it is, too, making the theaters unfit for the presentation of spectacular plays. And in a performance of that kind it is impossible to secure fine effects unless we have the proper lights to display the scenic effects, the brilliant costumes and the pretty stage groupings. Philadelphia is even worse off than New York. There are only two theaters in that city that are lighted by electricity, and neither of these can hold a candle to the theaters of Chicago."

Chicago Electric Club.

The Chicago Electric club last Monday evening listened to an interesting paper by Alex. Dow on the "Regulation of Constant Current Dynamos." The paper is presented in another column. B. E. Sunny, chairman of the committee on new quarters, reported that suitable rooms could not be secured elsewhere, and recommended that the club retain its present quarters another year, utilizing one of the back rooms for a kitchen. The question of the nomination of officers for the ensuing year was taken up and a ticket nominated.

Combined Water Motor and Dynamo.

In the accompanying cut is shown a combined water motor and dynamo built as one machine upon a single shaft. It will be readily seen that this machine has many advantages for special cases, especially in places that have no regularly established plant for electric lighting. Then there are many residences in larger places



COMBINED WATER MOTOR AND DYNAMO.

so located that they cannot obtain light from local plants, and, in order to enjoy the benefits of such a system of lighting, must make use of some power for running dynamos. These machines are in special favor with water power companies, and many have already been installed by them. They are built in 10, 20 and 30 light sizes, and are capable of bringing these lights to full candle-power under a maintained pressure at the motor of 65 pounds, to give the required speed. The manufacturer does not recommend these machines for a lower pressure. These dynamos are also built and furnished with pulley for belt connections to be run by motors where the pressure is below a point where they can be in direct connection upon the same shaft, or to be used in connection with steam or other power.

Special machines in all sizes ranging from 10 to 100 lights capacity have been installed. The Belknap Motor company of Portland, Me., is exploiting the device.

The Westinghouse Automatic Circuit Breaker.

Street railway men who have had experience with the ordinary fusible block and make-and-

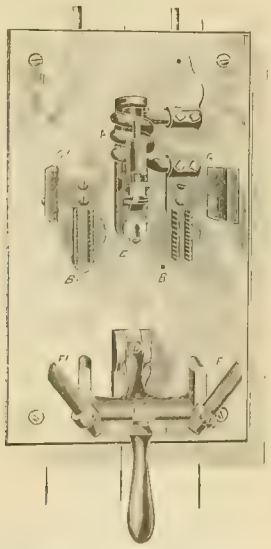
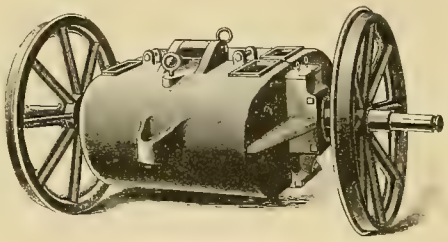


FIG. 1. WESTINGHOUSE CIRCUIT BREAKER.

break switch know how difficult it is to keep the switch-boards looking well, especially when there have been a number of short circuits on the line. Not only are the safety-fuse blocks burned and discolored, but the portion of the switch-board near the safety fuse is damaged, the jaws of the switch are partly melted or fused, and the whole presents anything but a neat appearance. The Westinghouse Electric & Manufacturing company has devised an automatic circuit breaker for this work. The device, which is illustrated in the accompanying cuts, breaks the current automatically whenever there is a short circuit on the line, it is claimed, without burning or disfiguring the breaker itself. It has been tested on as high a current as 900 amperes and 500 volts, or a total of 450,000 watts, without affecting or burning the breaker. Fig. 1 is a view of the breaker when open, and Fig. 2 represents it closed. The device consists of an electro magnet *A* in series with a double break switch *B* B^1 and B^2.



WESTINGHOUSE GEARLESS MOTOR.

If a short circuit occurs on the line the electro magnet will attract its armature *C*, and with it the trigger *D*, which holds the switch closed, permitting the spring *E* to throw the lever arm out of the contacts. This, however, does not yet open the circuit as the carbon contacts *F* and F^1 carried by the lever arm still touch the carbon plates *G* and G^1 at the sides of the switch, and at these carbon points the circuit is finally broken without injuring in the least the metal parts of the switch. The feeder switch should always be opened before the circuit breaker is closed again. The Westinghouse Electric & Manufacturing company makes two

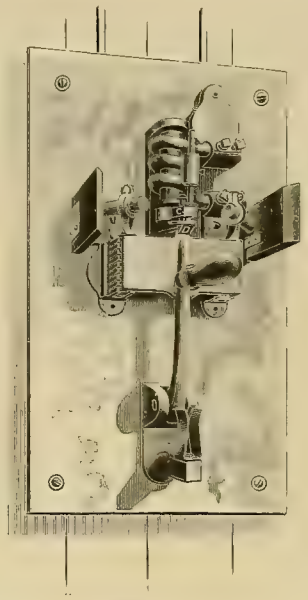


FIG. 2. WESTINGHOUSE CIRCUIT BREAKER.

styles of circuit breakers. These can be used in connection with any street railway system.

Westinghouse Gearless Motor.

The Westinghouse Electric & Manufacturing company announces that it has placed upon the market a gearless street railway motor. A view of the machine mounted on the car axle is presented in the accompanying illustration. It is protected by the field frame, which forms a casing strong enough to withstand the shocks and obstructions of the roadbed. The field consists of two symmetrical castings of special iron sleeved upon the armature shaft or axle, hinged on top, and secured together by bolts. The joints are made water-tight, and the bearings are provided with leather cups for the same purpose. The armature, which is of the drum type, is built upon the car axle. The sheet iron disks are solid, and are keyed to the axle to give additional strength. The armature is 16 inches in diameter with a grooved periphery for the wires. Special attention has been given to making the commutator of great solidity and durability.

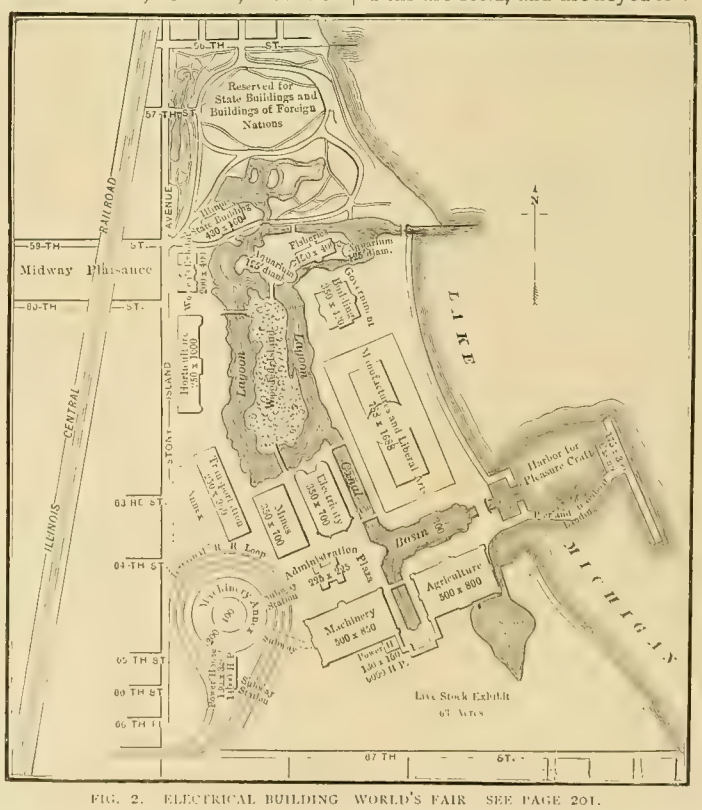


FIG. 2. ELECTRICAL BUILDING WORLD'S FAIR SEE PAGE 201.

Chandler's Elevated Tricycle Road.

A novel electric railway is exhibited in the accompanying illustrations. It is the invention of J. G. Chandler of Racine, Wis., and is termed a tricycle road for elevated structures. A model is on exhibition in the Grand Pacific Hotel, Chicago. It is illustrated in Fig. 1, and a sectional view of the road and truck, as it is proposed to construct it, is shown in Fig. 2.

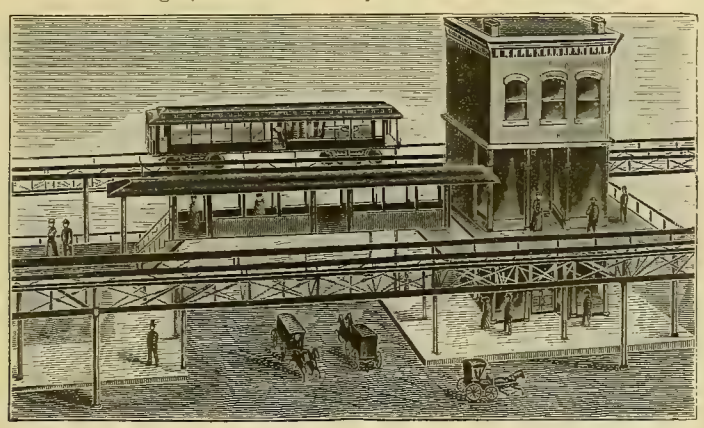
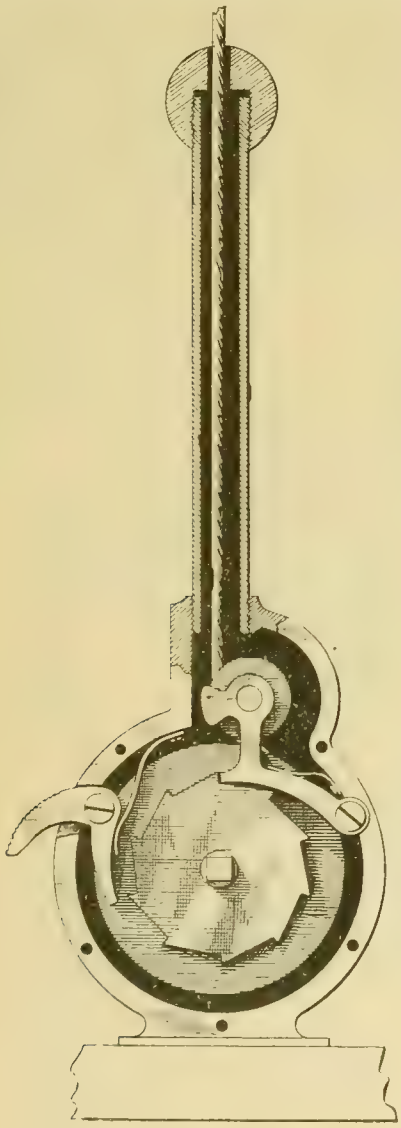


FIG. 1. CHANDLER'S ELEVATED TRICYCLE ROAD.

By reference to the cuts it will be seen that the trucks run on a single rail with two guide rails two feet above and parallel with the main rail. These with the diverging trusses make a V shaped trough for the trucks to run in. The track is made of iron and is supported on a single line of posts. It does not materially obstruct the light it is claimed, and, its inventor asserts, it is an ornament to the streets compared with the roads now being built in Chicago. The trucks have two wheels, one behind the other, the same as the safety bicycle, with two guide wheels running along the inner side of the rail. The flange extends inward and over the wheels, making it practically impossible for the car to leave the track. Each truck has an inclosed frame large enough to receive a thirty horse power motor. There are two trucks to each car, so arranged that one or both motors can be used at option. Special care has been taken to avoid all possibility of accident. In ordinary railroad trucks, if one wheel falls out it derails the whole train; with this construction either or both of the main wheels can break or fall to pieces, it is claimed, and the car will still remain in its position. In case of such an accident, provision has been made to prevent a catastrophe. Between the two wheels are runners fastened to the truck frame, made spoon shape, lapping over each side of the rail and running within two inches of the top of the rail, so that the moment the wheels give way, these runners strike the track, support the load and form a brake to stop the train.

Another advantage claimed for this system is the short turns it will make with safety; enabling a 45 foot car to pass around a 20 foot radius. It is the intention of the inventor to have long and narrow cars with three exits.

In connection with the elevated road Mr. Chandler proposes to have elevated sidewalks. Property owners oppose elevated roads generally considering them a detriment, as they obstruct light, etc., but he thinks they will consider this road an advantage to property as its elevated walks make the second floor valuable for stores. According to his design, the first floors will remain as at present but the fronts on the second floor are taken out and recessed back 6 to 8 feet. The glass of the show window below extends 2 feet above the elevated sidewalk, with a slanting top also of glass, so that the light comes into the store below through the glass above the walk; in this way people on the elevated walk can view the show window in the store below. The track is made so light and open that there will be no objection he thinks to such a structure; and the trucks are made so that they will run noiseless.



AUTOMATIC TROLLEY CATCHER.

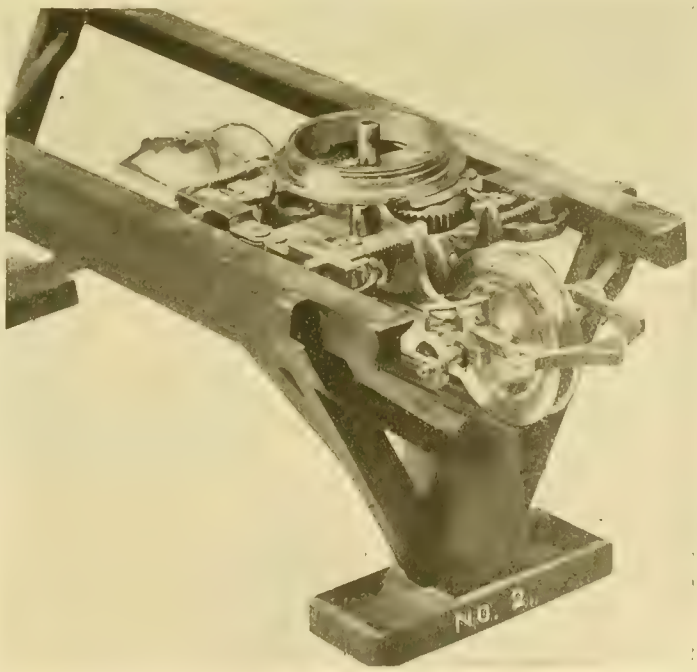
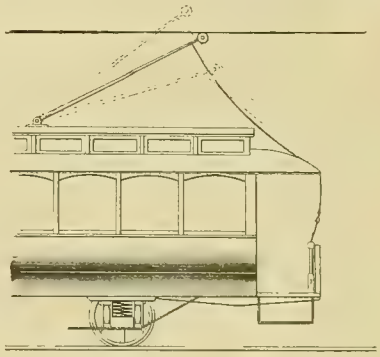


FIG. 2. CHANDLER'S ELEVATED TRICYCLE ROAD.

Automatic Trolley Catcher.

That electric car trolleys, in spite of a number of precautions, do not always keep in place even on the best constructed roads, is a fact which unfortunately cannot be denied. It was with the object of catching the trolley when it slips from the overhead wire and automatically drawing it down below the wire, that the ingenious little device illustrated herewith was designed.

A glance at the cuts will enable the reader to easily understand the construction of the catcher. The device consists essentially of a drum containing a coiled spring, combined with a ratchet wheel and two pawls as represented. The operation of the catcher is as follows: The trolley cord is so adjusted in length that it has, say, six to twenty inches of slack. When the trolley wheel runs off the wire this slack is taken up with a jerk and the pull of the rope against the pawl in the catcher liberates the coiled spring. As the coiled spring is always kept wound up, the moment the pawl is pulled out of its place on the ratchet wheel, the reel spins around, winding up the cord and pulling the trolley-pole down below the wire. The machine will continue to hold the trolley in this position until the conductor or motor man pulls out the trolley-line from the catcher and places the trolley against the overhead wire.



AUTOMATIC TROLLEY CATCHER.

It will be noted, of course, that the pulling out of the cord in order to replace the trolley wheels against the wire rewinds the spring of the catcher. This device is the invention of Byron J. Parsons of Omaha, Neb.

Stanley Transformer.

In the accompanying illustrations are shown an improved transformer placed on the market by the Stanley Electric Manufacturing company of Pittsfield, Mass. In this device there is no secondary fuse in the converter, the inventor believing that it is only an element of trouble, because the secondary, as a rule, is supplied with a fuse where it enters a building. The primary fuse wire is carried on a porcelain block or plug, and can be secured in place when held in the hand, and good contacts surely made. The station may have a number of extra plugs, and, to replace a fuse which burns out, it is only necessary to open the door by turning a thumb-screw, remove the plug, insert another and shut the door, or attach a new fuse and replace the same plug. The same size of plug fits all different sizes of transformers up to one hundred lights. The fuse box is made of porcelain, and every part is insulated and fire-proof.

In the cuts, Fig. 1 shows the transformer in position ready for use, and Fig. 2 gives a view of the device with the front plate removed, showing the arrangement of the fuses.

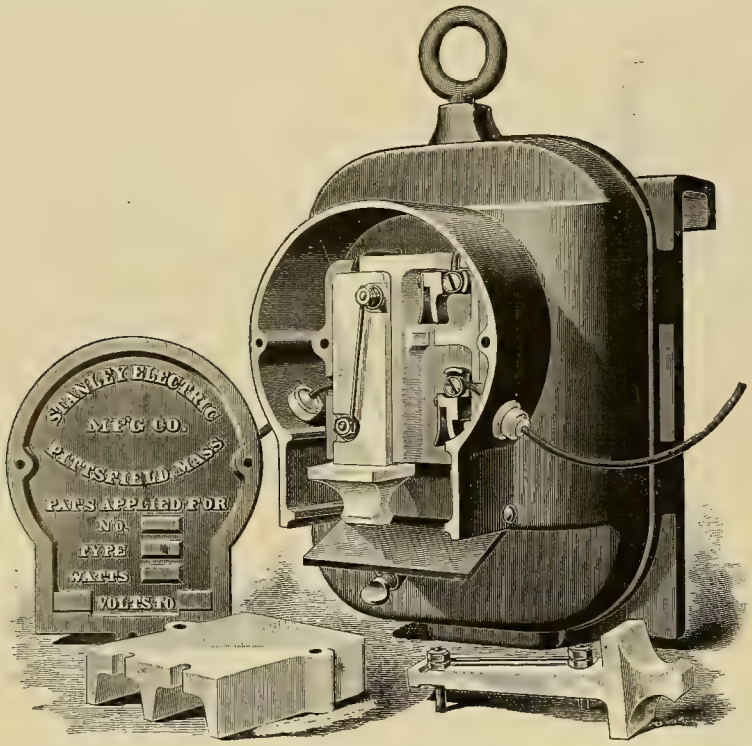
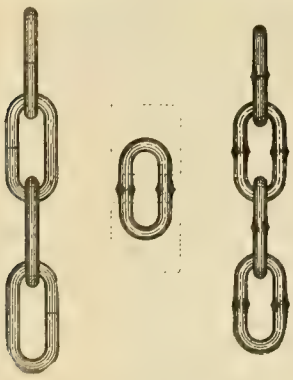


FIG. 2. STANLEY TRANSFORMER.

Electrically Welded Chains.

To weld straight bars of metal by electricity is a creditable feat, but to unite two parts of an irregularly formed metal piece is far more difficult. In developing the electric welding process in order to obtain the full advantage of the employment of electricity as a heating agent, it has been found necessary to devise a great number of special auxiliary devices and methods. An illustration of one of the wrinkles which have been resorted to is given in the cut.



FIGS. 1, 2 AND 3. ELECTRICALLY WELDED CHAINS.

The method described is one which was devised by Prof. Elihu Thomson to facilitate the manufacture of chains. The process is exceedingly simple. It consists in taking a piece of metal rod and bending it to approximately the desired form, at the same time threading the bent link through a previously formed link or bent link. Proceeding in this manner, a chain, Fig. 1, of any length is constructed, and then the meeting ends of each link are electrically welded together. In carrying out the welding process the joint is formed either with or without the production simultaneously of a protuberance or enlargement at the opposite side of the link. Prof. Thomson prefers, however, particularly in the manufacture of small chains, to heat both sides of the link—that is to say, to heat the link not only at the point where the weld is to be formed, but also at the opposite side. The reason for this is that it is easier to include both sides of the link in the clamping devices and to pass the current through both sides simultaneously, so as to heat them to the welding and upsetting temperature.

Figs. 2 and 3 show the manner in which a link is upset and a chain formed.

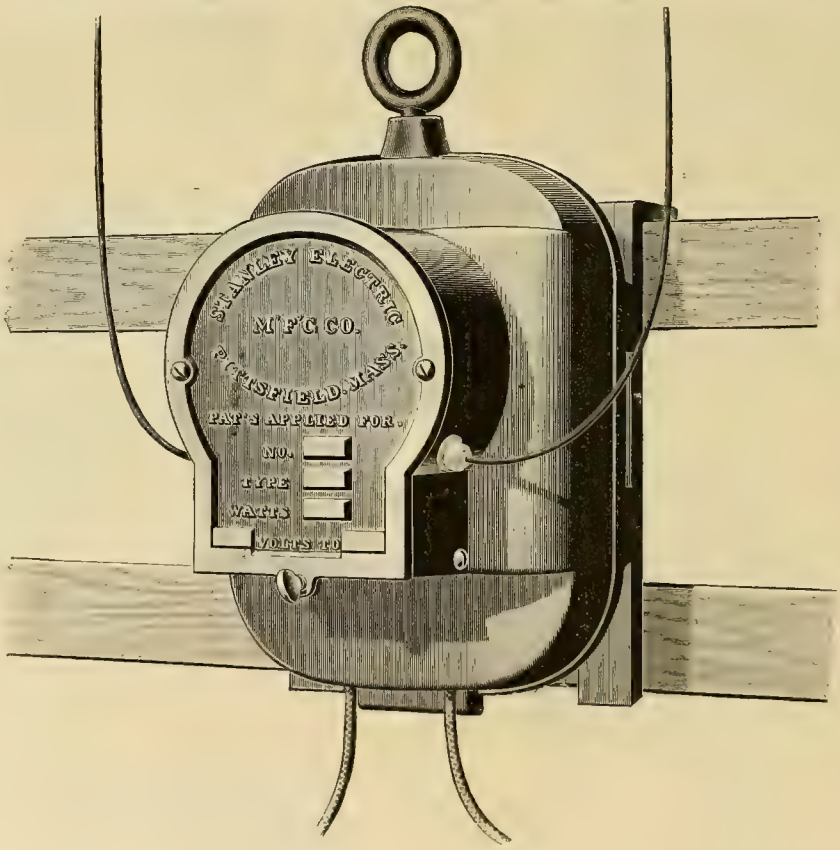


FIG. 1. STANLEY TRANSFORMER.

Electrical Problems for the Lawyers.

One of the effects of the rapid introduction of electrical inventions during the last quarter of a century, has been to open up entirely new fields of litigation for the lawyers and new questions for the bench. This in a general way, says the Boston *Journal of Commerce*, is true of every new creation of industrial property, but with electricity many of the problems to be solved are quite novel, and a judge has often to go wide of practice and precedent before he can determine the legal principle proper to apply in the case before him. Thus for instance, in Pennsylvania, the question has recently been adjudicated upon whether a local electric light company was a manufacturing concern. The court says it is not, and yet all that it does is to make the current for sale.

A similar point is that raised as to the dutiability of electric current. The law officers of the treasury say it is intangible, and therefore pays no duty; yet it can be measured to the minutest fraction. The Western Union company has had many a fight as to whether pole lines had any right on the public highways, and Massachusetts says they have, as transporting messages is part of the work of intercourse for which roads are laid out and maintained. The American Bell Telephone company for years spent hundreds of thousands of dollars in defending the abstruse doctrine that telephonic speech can only be transmitted by an undulatory current, that a make-and-break current would not do it, and that other devices are simply a juggle to get around Bell's patent. In electric lighting, millions of investments have hung on a "filament," and on the exact meaning that the courts might attach to the word. Among the latest legal fights is one that probably the United States Supreme Court will have to settle, namely, whether the telephone companies or the electric railway companies have the right to use the earth as a "return." The telephone people claim that the leakage from the railway throws their service out of gear and renders the instruments useless.

The railway people reply that their telephonic friends have a remedy in metallic circuits, and that no one electrical interest anyhow can "own the earth." Already this dispute has cropped up in nearly a score of states, and the increasing number and magnitude of the electric roads renders it more and more important. In the meantime, the telephone companies as far as possible are putting their metallic circuits in, with a marked improvement in the service New questions thus crop up every day. In the use, for example of the alternate currents now becoming so common, not a little has depended on the patentability of the principle of transforming the current, and on whether a "step up" was equivalent to a "step down"—in other words, whether raising the voltage and decreasing the amperage was a simple and inevitable converse to decreasing the volts and raising the amperes. Another point around which legal controversy has gathered is the fine one as to where "low" potential ends, and "high" potential begins.

Ferranti's Meter.

The principle of the Ferranti electricity meter is the measurement of the rotation of a bath of mercury through which the current passes from the periphery to the center after energizing a

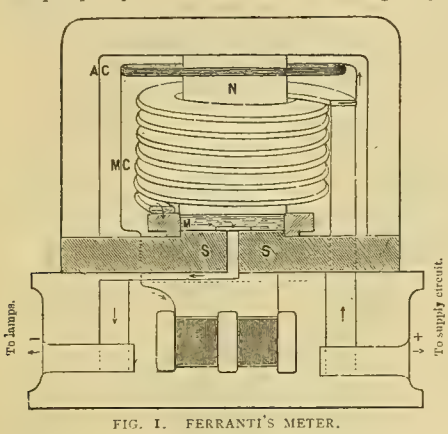


FIG. 1. FERRANTI'S METER.

magnetic field, the lines of force of which are at right angles to the radial direction of the current in the mercury. The speed of rotation increases in proportion to the current, and the movement is transmitted to the register by a fan which is mounted on a light spindle and immersed in the bath. The registering portion of the meter is as simple as the other mechanism. The face of a meter is marked with six dials—units, tens, hundreds, etc., and the amount registered on these dials, when divided by the constant stated in the instructions, will give the number of Board of Trade units consumed. An important feature claimed for the Ferranti meter is the extremely small amount of energy required to work it, and the consequent absence of any observable drop in volts. There is only one moving part, and this is perfectly inclosed in a metal case so as to be inaccessible.

It is asserted that the correctness of the record is not impaired, as would be the case in some other direct current forms, by a magnet being placed near the meter, as might be done by a dishonest consumer. The meters do not require to be touched for winding up or recalibration. As regards accuracy, a great disadvantage of some other forms of meter is an inability to start registering at a small fraction of full load, that is to say, when the friction of the working parts is greatest relatively to the force to overcome it. A consideration of the design of the Ferranti meter will show that in it this friction is at a minimum, but even so far its effect is largely reduced by a simple and effective device consisting of a fine wire coil through which a minute shunt current passes around the iron core and produces a strong magnetic field relatively to the small current passing through the bath at low readings. In some sizes of direct current meters the residual magnetism of the field is arranged to take effect, and the fine wire coil is dispensed with. By this means Ferranti meters will start registering, it is claimed,

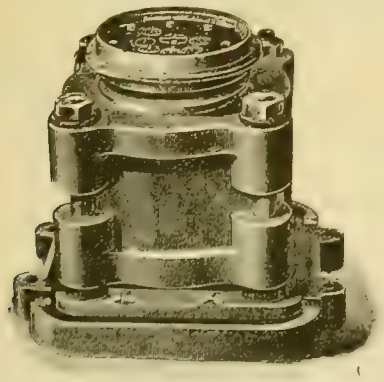


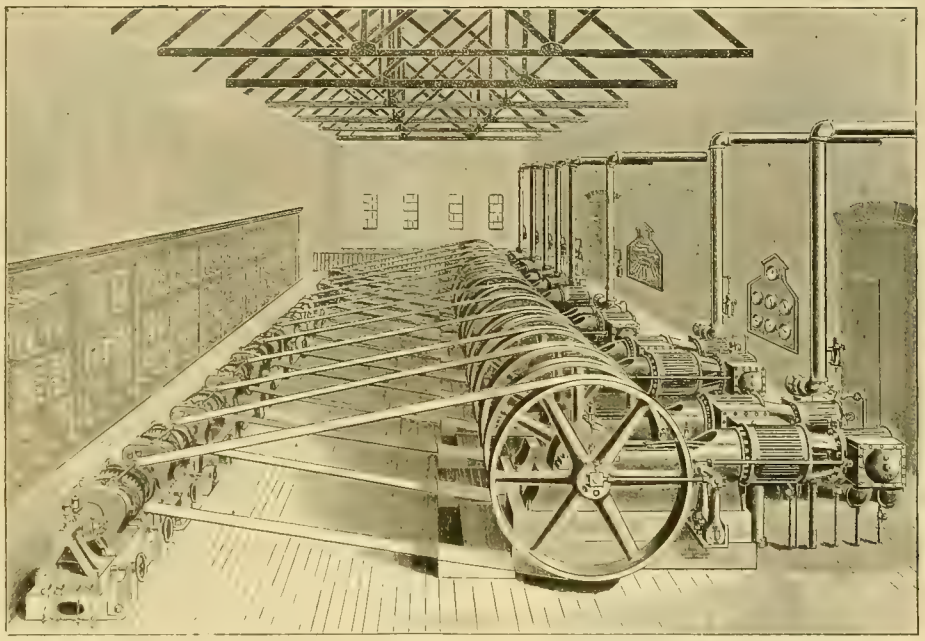
FIG. 3. FERRANTI'S METER.

at about one per cent. of their limits of load, and will register with less than three per cent. error over ninety-seven per cent. of their working range; *i. e.*, a 100 ampere meter will start registering at one ampere, and will register correctly from less than three to 100 amperes.

Referring to the cuts, in Fig. 1 *M* is the mercury chamber, *A C* is the auxiliary coil, *MC* is the main coil and *R* is a resistance in series with the auxiliary coil. Figs. 2 and 3 show respectively a 10 and 40 ampere Ferranti meter with the case removed. The description and cuts are taken from the London *Electrical Review*.

Rochester Electric Railway Power House.

The Rochester, N. Y., electric railway system is, perhaps, one of the most complete equipments in the country. Its power house, which is illustrated in the accompanying cut, is designed for an ultimate capacity of 2,500-horse power. The present equipment consists of 13 generators of the Short type, arranged as shown, and driven by Ball engines. There are two 300-horse power triple expansion engines, one cross compound 250-horse power and three standards of 150-horse power each. The triple expansion engine makes 211 revolutions per minute, and drives two generators, the cross compound 215 revolutions. It also drives two generators. The standards make 238 revolutions, and each runs one generator. The cross compound and triple expansion are run condensing, high speed. The driving wheels of each of the engines are eighty-four inches in diameter, and are belted direct to the generators without counter shaft-



ROCHESTER ELECTRIC RAILWAY POWER HOUSE.

ing. The dynamo belts are oak-tanned, sixteen inches wide, double-ply, and were manufactured by the Jewell Belting company of Hartford, Conn. The power will presently be increased by the addition of two 300-horse power cross compounds of the same type.

The company at present is operating thirty-eight cars equipped with Short motors and other lines will be added early in the spring. The entire city will be furnished with electric railway service within a year it is hoped. The cut of the dynamo room presented herewith is reproduced from the *Street Railway Journal*.

Support for Arc Lamps.

The demand for arc lamps to be used temporarily is growing. The lighting of railroad wrecks, unfinished buildings upon which work is continued after dark, and the illumination for an evening of parks and gardens—all this is creating a demand for fixtures which may be quickly put in place and as rapidly removed. An illustration of the tendency just referred to will be found in the lamp bracket shown in the cut. The purpose of the designer, H. A. Foster of New York, was to provide a cheap and simple device which could be readily attached to a building or any similar support.

The most essential feature of the device is the main rod with its lower pointed end. The other details of the hanger and the manner in which it is guyed to a building or scaffold will be understood from the cut.

Electric Mining Plant.

What is said to be one of the largest electric mining plants in the world has been contracted for by the Coeur d'Alene

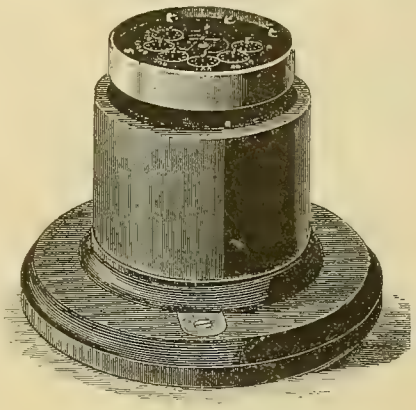
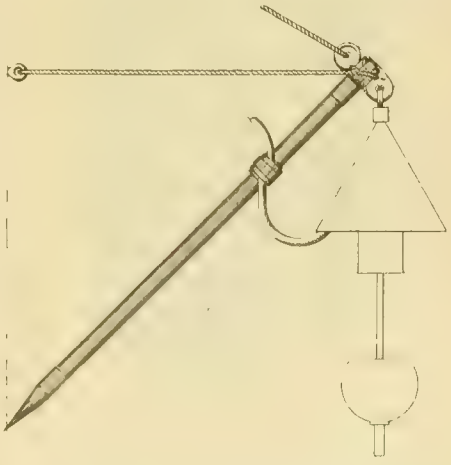


FIG. 2. FERRANTI'S METER.

Silver Lead Mining company at Burke, Idaho. The plant consists of two 225-horse power Edison generators to be located about one and one half miles from the mill and driven by water power, using Pelton wheels under about 600 feet head. The mill machinery will be driven by an 80-horse power motor belted direct to the main shaft of the mill. The Ingersoll steam drill compressor now in use will be operated by a 60-horse power motor belted to the fly wheels of the compressor. The Lidgerwood steam



SUPPORT FOR ARC LAMPS.

hoist now being used will be operated by a 50 horse power motor geared direct to the present driving shaft. The pump, located on the 500 foot level, will be driven by an 80 horse power motor geared direct.

The entire plant of this mine is at present operated by steam, and the application of electricity will be so arranged

that all the machinery or any portion of it can be operated by either steam or electric power at any time. The entire electric plant will make about eight car loads and will probably be the largest single shipment of electrical machinery that has ever gone west of the Mississippi river.

Magnetic Vane Ammeters and Voltmeters.

The accompanying illustrations represent Queen & Co.'s latest magnetic vane ammeters

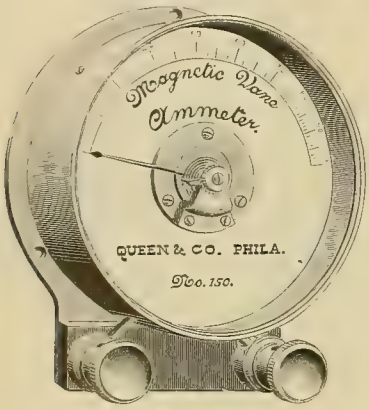


FIG. 1. MAGNETIC VANE AMMETERS AND VOLTMETERS.

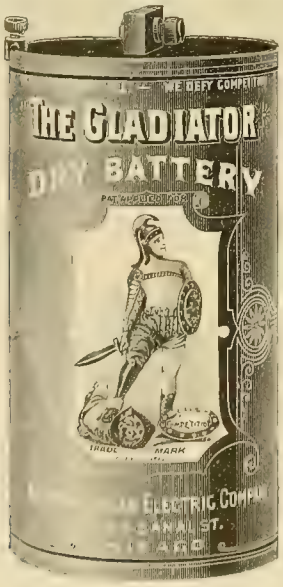
and voltmeters for stations. The construction of these instruments has been somewhat changed since they were first placed on the market. Queen & Co. claim that their "magnetic vane" instruments are accurate enough for commercial purposes. The instruments contain no delicate parts liable to injury, and in consequence are well adapted to the usage which station instruments necessarily receive. The voltmeters, as well as the ammeters, can be left in circuit, so they may be fastened permanently on the switch-board, if desired.

The "magnetic vane" instruments are designed especially for central stations, isolated plants, marine installations and railway work, and are well adapted for general experimental work.

For central stations the large ammeters, Fig. 1, have special cut-out plugs, so they can be left in circuit or not, as desired. They are made to measure currents of any desired quantity. The smaller ammeters, Fig. 2, are suitable for isolated installations.

In marine work the "magnetic vane" instruments have been largely used with most satisfactory results.

The voltmeter, Fig. 3, is intended for electric



DRY BATTERY.

railway engineering. It is calibrated up to 600 volts, and has a special short circuit key for rapid work.

Dry Battery.

A new, long life, dry battery, the "Gladiator," is now being introduced by the North American Electric company, Chicago. The cut shows the cell as it is prepared for delivery. The voltage is claimed to be 2.5, and the resistance is said to be extremely low. This cell is manufactured especially for bell work but, of course, is adapted for any other service to which the ordinary dry battery is generally applied.

English Megohm Plates.

The English megohm plate illustrated in the accompanying cut is designed to take the place of expensive and cumbersome wire resistances having approximately equal values in ordinary use in measuring commercially the insulation resistance of cables, air-lines, etc. The device is only 9 inches in length and 7 inches in width, and, exclusive of the binding posts, 2 inches in height. The binding posts, however, as is customary, stand about 2 inches above the base of the instrument. The whole weight of the device is about 3 pounds. The plate is placed on the market by the E. S. Greeley & Co., New York.

Electric Drill Tested.

The Edison General Electric company gave an exhibition of its electric percussion drill at Quincy recently which was attended by a large number of quarry owners from different quarries in Massachusetts, as well as by a large number of mine owners from Boston and Canada. The result of the exhibition was satisfactory. Two steam drills, working in the same quarry, gave an excellent chance for comparison. Although the stone in Quincy is exceptionally hard, the electric percussion drill was able to drill a hole 1 1-2 inches in diameter at an average rate of 2 3-4 inches per minute, with an expenditure of less than 4

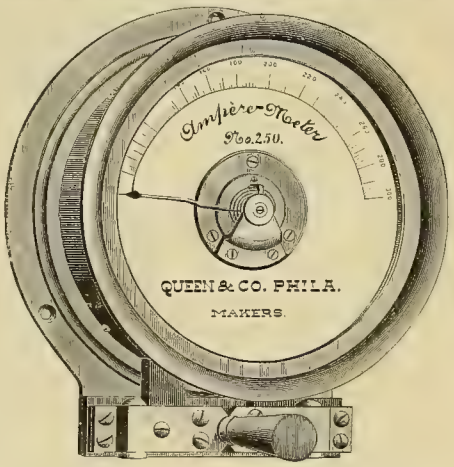


FIG. 2. MAGNETIC VANE AMMETERS AND VOLTMETERS

horse-power delivered to the generator. At one time the rate of drilling was as high as 4 inches per minute. Among the special features brought out by this exhibition were the extreme ease with which the power could be transmitted to the drill from the generating station, and the great simplicity of the machine itself. The wires were taken from the edge of the quarry direct to the place where the drill was at work, without any further intermediate supports being needed. The distance along the wires was 350 feet; the vertical distance between the drill and the edge of the quarry 100 feet. For the purpose of exhibiting the ease with which the machine could be taken to pieces and defective parts replaced by others held in reserve, the drill was several times opened and entirely taken apart, the time required for this being less than three-quarters of an hour. To do the same thing with a steam or compressed air drill would require a very much longer time In case of accident to the last mentioned drill, it would have to be repaired by a competent mechanic, and it would be some time before it could again be used; whereas, with the electric drill it was shown that any accident to one or the other of its parts could be remedied within three-quarters of an hour by simply taking out the defective part and dropping in another one held in reserve, as the parts of the electric percussion drill are made according to standard sizes and are interchangeable. The drill was illustrated in the WESTERN ELECTRICIAN April 12 1890.

Single Duct Conduit.

The Interior Conduit & Insulation company, has adapted its insulated tubing to fit telescopically into wrought iron pipe. The full space between the tubing and the iron is filled with insulating compound, shutting out moisture and gases. The pipes as illustrated are made in 10 foot sections, and when laid are united by wrought iron couplings. In laying, these sections are converted into a continuous duct having practically no junctions, by the insertion of individual insulated tubes whose lengths are the same as the iron pipe sections, but whose external diameter is slightly less than the internal diameter of tube contained in the iron pipe.

This conduit is specially adapted for use by arc lighting companies and others employing a series system. It will also be found desirable for carrying the feeders of electric street rail-

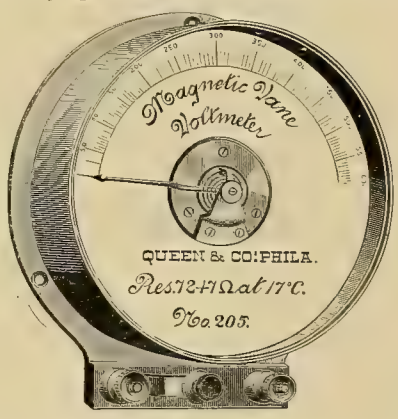


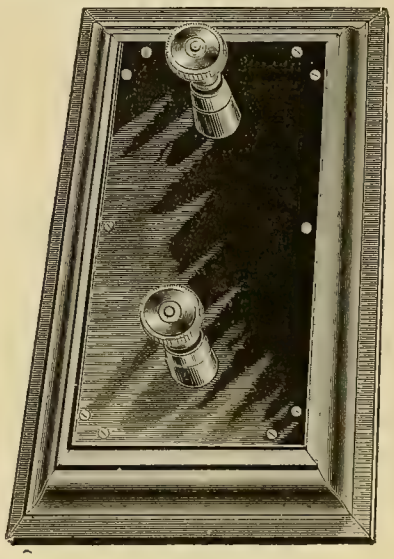
FIG. 3. MAGNETIC VANE AMMETERS AND VOLTMETERS.

road lines—in fact, in any place where a single duct conduit of high insulation is required.

Exaggerated Fears.

In a thoughtful article on "The Fear of Electricity," *Lock and Bell*, after alluding to the panic in New York caused by the death of about a dozen linemen from electric wires, makes the following sensible observations: "It is doubtful if man has ever harnessed a force of any other kind, and turned it into his service in the production of power, that is so easily made tractable as is electricity. The original motor, the horse, is notoriously an ungovernable creature; and if his victims of a single year could be reported, their names would make an appalling list.

"The steam engine has greatly reformed in recent years; and it is well that this is true, for were it as destructive now as it was in the days when it first began to paddle steamboats up and down the Mississippi River its multiplication would long since have been prohibited by law. But it is still much more destructive than electricity, and

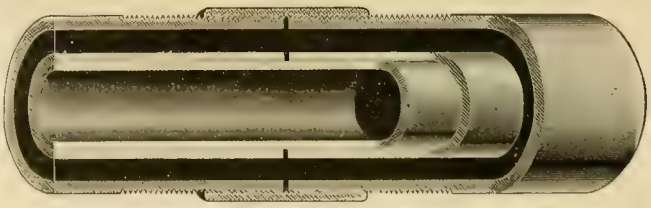


ENGLISH MEGOHM PLATES.

much more terrible in the exercise of its destructive powers. Yet men sleep over it in the cabins of a flying steamer with no sense of fear.

"Men have a great dread of the invisible, and it is probable that this is the secret of their fear of electricity. What they see they think they can provide against; but an invisible danger goes direct to the marrow.

"Will men ever overcome this dread of electricity? It is to be hoped not to the measure that will serve to make them careless, and it is to be presumed not until they be-



SINGLE DUCT CONDUIT.

come universally indifferent in a thunder-storm. They may so far overcome it that they will never again be in danger of making exhibitions of themselves as they did in New York, or of finding in the cowardice of the multitude a ready means of obstructing electrical enterprises."

Regulation of Constant Current Generators.[1]

By Alex. Dow.

Electric power expressed in watts is a product of two factors, the electromotive force and the volume of the current carrying the power.

A change in the total power of the current may be expressed by a change of either factor, or of both. In distributions of electric energy it is usual to provide for adjusting the production to the requirements of the work by

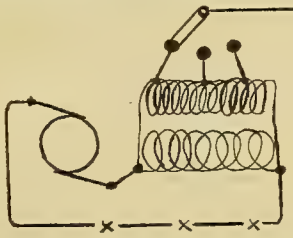


FIG. 4.

varying only one factor, the other being maintained constant from minimum to maximum production. Thus we have two commonly recognized methods of distribution at constant electromotive force, and with constant current. There are cases in practice where both factors may vary; for instance, when a series wound dynamo operates one series wound arc lamp, or when a shunt wound machine is employed to charge one set of accumulators; but you will notice that in such cases there is but one device absorbing energy. Where there is more than one absorber, the difficulty of keeping each of these in unison with the other compels the adoption of a one-factor regulation of the generator.

It is impracticable to supply from the same generator two devices, one of which requires a low electromotive force and a large current and the other a greater electromotive force and a smaller current. But if they are alike in either requirement their operation together becomes practicable.

We may say that it is this operation of more than one receptive device by the one generative circuit, this division of the energy, that has caused the differentiation of the two methods of distribution. And designers of electrical machinery have adapted their apparatus particularly to one or the other of these operating conditions, and have in their dynamos provided for the maintenance of the selected condition. This paper is a study of the regulation of constant current dynamos.

The book of the constant current dynamo is yet unwritten. The constant potential dynamo has its literature by libraries, and the literature of the transformer is accumulating daily, but the constant current dynamo is neglected by the book maker. Those who wish to study it must go to the machine itself, and they will find it the least understood and the worst treated of all electrical generators. I have thought that a paper on this subject based on observation and practical study would be of interest to the club.

The theory of the dynamo electric machine as commonly taught is that the electromotive force developed by any dynamo depends on the rate at which the conductor under induction cuts lines of magnetic force. For the purpose of this paper we will accept this theory; and as regulation of the output of a constant current dynamo means changing its electromotive force, we see that any method of regula-

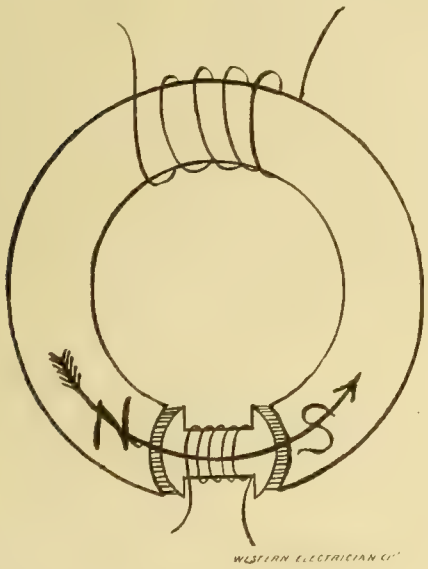


FIG. 1.

tion is necessarily a method of changing the rate of cutting of lines of force.

In practice this cutting is by the conductors of an armature revolving in a magnetic field, and we see several possible ways of obtaining a change of rate. We can change the velocity of the conductor, run the armature at a lower speed, and so do less cutting in a given time. Or we can reduce the number of lines of force intersecting the path of the conductor—reduce the "strength of field" as we say—and so give the armature wires less lines to cut. Or, third, we can change the length of conductor; the greater effective length of an armature wire there is in the field, the more cutting it will do per revolution. Any of these, or any combination of them, will serve to regulate the electromotive force.

The first way is the simplest and most efficient. Change of speed will alter the electromotive force of a dynamo, without complication and with absolute accuracy, right down to the point at which it merely charges its own field magnets. I have an old table in my possession showing the proper speeds of certain dynamos for any number of arc lights from one up to the limit of each machine. It looks a little odd to-day to see the speed stated as "sixty revolutions for one light and sixteen revolutions for each additional light." We are accustomed to setting speed for full load, and letting our automatic governors or engines or dynamos take care of any reduction of load. My own practice, when I have a plant with engine and dynamo capacity much in excess of present requirements, is to set speed at the minimum and increase it from time to time as increased business requires. Most automatic cut-off engines will govern at any speed within a wide range; and I gain electrical economy, a reduced friction card, and a saving in steam by reduction of cylinder condensation. The theoretical economy is obvious. The belt power is as torque by speed. The torque remains constant with the current, and the total power is reduced directly with the speed.

In water power plants regulation by speed is common. I saw recently a neat instance of this. The plant is two 20-light arc dynamos. There is an automatic governor to

FIG. 3.

each dynamo, but these are depended on only to compensate for difference of load between the two machines. The attendant is guided by the ammeter of the machine carrying the heaviest load, and regulates entirely by the hand-wheel controlling the water gate. It is interesting to note that the brushes need no attention when change of load is met by change of speed.

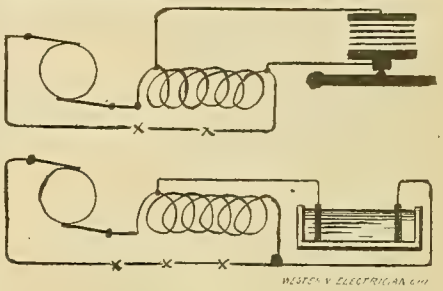
Regulation by changing the strength of the field has been brought to perfection in constant potential working in the shape of compound winding. It is used also in constant current work, many of the most familiar devices depending primarily on change of field. But compound winding is not used to any extent; such winding for constant current is "a hard road to travel." The first difficulty is to design a commercially and mechanically practicable shunt-field for high voltages. Shunt wound arc dynamos have worked up to 1,200 volts, and worked well under favorable conditions. But 1,200 volts is too low for recent practice, and conditions are never favorable to an arc dynamo—well, hardly ever. With the open coil dynamos which have two or three independent commutators connected in series, it is possible to compound by a shunt connected to one commutator only, the shunt thus taking half or one-third of the total voltage. Power generators of this type are doing excellent work, but the extreme changes of lead under variation of load limit the applicability of these machines. Of course an automatic brush rocker is suggestive as the one thing needed to make them generally useful, but to make a brush-rocker keep step with the instantaneous changes of field is another hard road to travel. I believe that up to date, when a sudden change of lead is in order, the compounding gets there ahead of the brushes every time.

To make a brush-rocker work properly on any style of power generator is a nice problem. The changes in arc lighting are perfectly manageable. It's the utterly unreasonable changes that come when you have a lot of big motors on a series circuit, that show just how much momentum a rocker with little inertia and a perfect dash-pot can acquire. I counted the swings on such a rocker once when a big motor had been flicked off suddenly. I counted up to forty-seven and it was not quite done then.

But I believe that compound winding, with or without a rocker, will ultimately be the accepted method of regulation for constant current.

Before taking up the study of regulators of the field changing class, I must say something about armature reaction; *i. e.*, the influence of the armature magnetism on the density of the field. A good deal has been written on this subject in connection with the Stanley constant current alternator. I have not seen that machine, so I can say nothing about it, but any account of the familiar direct current regulators must take reaction into the reckoning. It is a feature of all and the most prominent feature of several, although it is invariably overlooked in published descriptions.

I want to make clear by a few diagrams the part which the armature of a dynamo constitutes in its magnetic cir-



FIGS. 5 AND 6.

cuit. I need not begin by a definition of the magnetic circuit; that idea, though it is only a conception of the last two or three years, has already reached the advertising department. But I state its fundamental law, in order to lead up to the statements to follow. It is that the magnetic flux in any circuit, that is, the total number of lines of force, or what we call the strength of field, is directly proportional to the magnetic motive force; that means, in a dynamo, the number of ampere turns in its windings and is inversely proportional to the magnetic resistance of the circuit. This last means that if the iron of the dynamo is poor, or the space between armature core and pole pieces is wide, or the field magnets long and thin, we won't get so strong a field for the same ampere-turns as if the iron were good and the clearances small and the magnets stout and short.

Now the magnetic circuit of a dynamo is a compound one. It is not all iron nor is it all air; it is iron and air and copper armature wire. The magnetic flux in this circuit under a given magneto motive force applied to the field magnets can be calculated, when the armature is not traversed by current, from the known magnetic resistances of the iron and air and copper. But so soon as there is current in the armature the circuit becomes complex as well as compound. The armature becomes a magnet in its own right in virtue of the current circulating in its windings, and its magnetism may and does oppose that of the fields. So that the total magnetic flux or strength of field is changed, and changes further as the current of the armature increases.

To illustrate this by my diagram, Fig. 1, let us conceive this armature to be free to move on its axis but not traversed by current, and the field excited by a constant current from some external source. We have thus a magnetic flux from pole piece *N* to pole piece *S*, which takes as part of its path the iron core of the armature. Here we have an ordinary compound magnetic circuit.

Now we will conceive, Fig 2, that the armature also is excited from some external source in such manner as to produce polarization *n* and *s*. We have now a marked tendency to get attracted poles in line in such manner as to get the best magnetic circuit, to get the straightest path for the lines of force. Or we may say in such manner as to

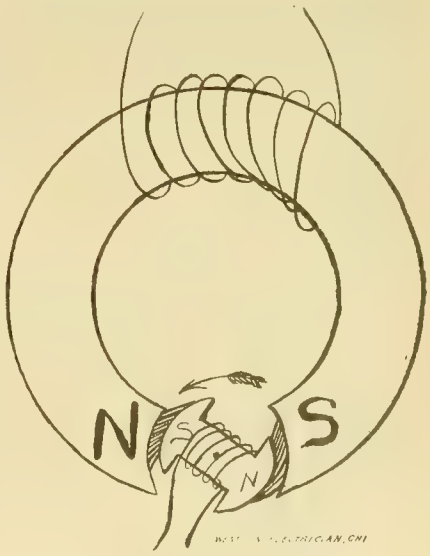


FIG. 2.

form from one big magnet the two independent magnets, the field and armature. This is what I call a complex magnetic circuit. There are two magneto-motive forces operating to produce a flux along the same path.

Our diagram as it stands only needs a commutator and brushes to be a motor. This pull between attracted, and corresponding push between repelled, poles is the working power of a motor. The commutator acts by reversing the polarity of the armature at the proper instant so as to make the attracted armature pole a repelled one and cause it to

(Continued on page 201.)

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IT is now two weeks since the WESTERN ELECTRICIAN called attention to the fact that the plans for the proposed electrical building at the World's Columbian Exposition did not provide for ample floor space for the accommodation of exhibitors, that the location of the proposed building would not admit of enlargement, and that it was the intention of the construction department to divide the electrical display among several buildings. This announcement was received everywhere with indignation; there were protests from all sides, and further information was demanded. Chief Burnham of the construction department was called upon, but he declined to make a formal statement. He admitted, however, that the information presented by this paper was correct in every particular, but pleaded that the classification approved by the directors made it imperative on his part to prepare the plans with a view of dividing the electrical exhibits.

In addition to the opposition of the leading representatives of the electrical industries, the Chicago Electric club entered a formal protest immediately following the publication of the first editorial announcement in the WESTERN ELECTRICIAN. Chief Barrett of the Department of Electricity also vigorously opposed the plans and served notice on the chief of the construction department that he would use every means in his power to have them rejected. Mr. Burnham promised to give the matter immediate attention, yet nothing has been done, nor is there any reason to hope for further action in the construction department. Every effort that has been made on the part of the electrical people has been opposed in this department. This has led the electrical fraterity to conclude that they must look for encouragement and assistance elsewhere. An appeal will be made to Director-General Davis, and through him to the board of directors, unless a satisfactory reply is received from the construction department this week. In the former event, the whole matter will be laid before the directors, and they will be called upon to say practically whether they desire an electrical exhibit as a feature of the fair. If they do, the demands of the electrical people must be granted, otherwise the electrical interests cannot be expected to participate. The demands of the electrical department are reasonable, and unless they are granted, the electrical section of the exposition so far as representing the progress that has been made in the art, will prove a dismal failure.

It cannot be claimed that the electrical people are obstructing the progress of the Fair work, on the contrary, they are endeavoring to hasten it. They have presented valid objections to the plans proposed by the construction department, and they have also suggested a solution of the problem. In another column is presented an outline sketch of the "Machinery annex" building, which they wish to substitute for the electrical building assigned them. Together with the addition indicated in the drawing, this building will give the floor space required by the electrical people. It has the additional advantage of being so situated that an electric railway line may be constructed around it, on which the several systems may be shown. Prof. Barrett favors this plan and has suggested it to Chief. Burnham, who assented, but afterward withdrew his consent. Chief Barrett has not given up hope of obtaining this building, however, and at present is endeavoring to secure it. It should be stated in this connection that unlike the other buildings the "Machinery annex," as it is called, has never been dedicated to any purpose nor has it been passed upon by the directors. It was placed upon the map merely to provide for just such a contingency as the present. An objection raised in the construction department is that another power house must be built at the structure now intended for electricity if the present plans are abandoned, and that building used as a machinery annex. This is not so, as all the power necessary can be furnished by means of underground systems to the other buildings from the electrical power house. This in fact is an excellent argument for the change, as it will give the electric companies an opportunity to display their long distance power transmission systems. The importance of this question cannot be over-estimated as upon the solution of the problem will depend the success or failure of what should be the most important feature of the exposition.

We cannot believe that the World's Fair officials will allow themselves to be placed in the unenviable position of jeoparding the success of such an important feature of the exposition. Yet, if they hope to have a creditable display, they must act at once.

Should they grant the demands of the electrical fraternity, we bespeak for them the hearty co-operation of all engaged in the industry.

ALEX. DOW'S paper on the "Regulation of Constant Current Dynamos," which was read at the last meeting of the Chicago Electric club, is presented in this issue. Mr. Dow treated the question of the magnetic current in a most original manner. The most important point brought out, and the one upon which, it may be said, the paper is based, is the alleged lengthening of the magnetic circuit due to armature and field reactions. Mr. Dow's paper is an able argument in favor of his suggestion that the phrase "lengthening of the magnetic circuit" be employed where it is desired to express the armature reaction effect.

THE constant reader of electrical journals, if a close observer, cannot fail to notice the absence of originality or decided merit in many of the electrical devices upon which patents are granted. In the present instance, however, it is only desired to call attention to a little piece of apparatus which speaks for itself as far as simplicity and ingenuity are concerned. The device referred to is described in another column and is called by the inventor a "trolley catcher."

While, doubtless, the catcher could be modified somewhat, and, perhaps, improved, the idea of automatically pulling down a trolley pole after an accidental displacement of the wheel, so as to prevent possible damage to the overhead construction, is certainly a novel one and deserving, at least, of mention.

THE gearless motor has come, but it must be acknowledged that with all our boasted progress in the solution of electrical and mechanical problems, the English, as far as the motor on the axle is concerned, have come to the front ahead of us. In a recent editorial suggested by the publication of a description of a type of street car motor with single reduction gearing, attention was called by the WESTERN ELECTRICIAN to the fact that apparently in attempts to do away with the "noisy gearing," it was an Englishman who was in the lead, and not an American. Since that time, however, there have been indications of advancement on this line by the American electrical companies, and to-day there are at least two types of street car motors on the market in which the armature shaft and the car axle are one. Now that the ideal equipment has been found we are beginning to hear criticisms. It has already been asserted that the motor on the axle equipment will be likely to prove a troublesome mechanism. The jarring of the armature, it is thought, will lead to its rapid deterioration. Criticisms of this character are to be expected, but in spite of all that has been said we believe that gearing on the electric car has had its day, and the armature will stay on the axle. Those thoroughly familiar with the details of armature construction are well aware that the building of this part to withstand constant jarring is more of a mechanical than an electrical problem. For years our motor builders have been studying the art of insulation, and to-day, owing to the knowledge gained through long and bitter experience, burn-outs from electrical causes have become, comparatively speaking, rare occurrences. It is not to be supposed, then, should the unfavorable predictions prove correct as far as first attempts are concerned, that the electrical engineer will be baffled by an almost strictly mechanical problem. Let the wires shift if they will, or let the armature core jar out of balance, the experience may cost a little, but in the next armature the defects will be corrected.

(*Continued from page* 207.)

be pushed around into position to be attracted by the other field pole and so on indefinitely.

Now we will conceive, Fig. 3, that we have a belt on our armature pulley and are driving it up to speed, and that the ends of the armature coil are closed on one another, say through an arc lamp. There will be currents induced in the armature coil, and these currents will polarize the core in such manner that each of its poles, *n*, *s*, are attracted and held back by the field pole which it is leaving and repelled by the field pole which it is approaching. That is, the work

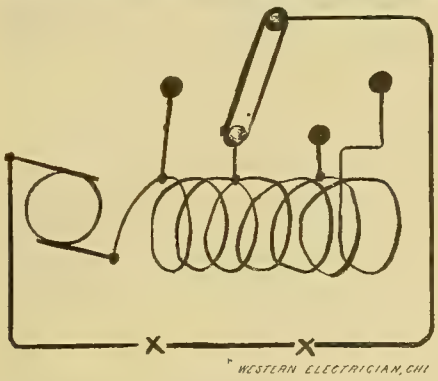


FIG. 7.

done in driving a dynamo, pulling attracted armature poles apart, and pushing them up to other poles which repel them.

I have selected the Siemens' shuttle armature with one coil because its shape lets the eye note readily the relation of the field and armature poles, but you understand that the many coiled armatures have just such poles and attractions and repulsions. The only difference is that their polarity is more constant, as the one coil armature is without current twice in each revolution, while the many coiled armature is able to maintain its current always. And you understand also that the position of the brushes decides the position of the polarity due to the armature currents, as it is to one brush and from the other that the currents circulate.

Now let us examine the magnetic circuit as a whole. We have recognized the effort of the magnetic flux to secure the shortest path, and that the shorter the path the greater will be the flux. We will place the armature of our diagram in the position for maximum induction of current in its coil, Fig. 3, The rotation is right-handed. Remembering that the pole of a dynamo armature which is leaving a field pole is always of the sign which that field pole would attract, we see that the upper armature pole is *s* and the lower *n*. Now let us lay out the course of the magnetic flux. We find that the lines which went straight across from *N* to *S* of the field magnet when the armature was not generating current cannot do so now. They are repelled by the lower end of the armature and obliged to bend upward toward the upper end. And they traverse the armature to its lower end, and again bend upward to reach the *S* field pole. You see that the resultant polarity of the area between the field magnets, which was formerly a straight line from pole to pole, is now a diagonal line, and that its departure from the straight line will be the greater the more the armature magnetism increases. That is armature reaction. I find it convenient to think of the reaction state as a lengthening of the magnetic circuit. You see the lines of force now take a crooked long path instead of the short straight path they had before the reaction commenced, and the effect on the field is just the same as if the magnets had been made longer or the air space made wider. You don't get so strong a field when reaction sets in, although your exciting current or magneto motive force remains the same. Indeed, in dynamos designed to take advantage of this reaction you don't get so strong a field for a greater exciting current.

I have not overlooked in preparing this paper the effects due to the induction of currents in the field windings by the armature. We must not forget that induction works both ways; that the inducing coils are subject to back induction from the currents they induce. This effect is very marked in separately excited alternators and produces peculiar results. I omit the matter intentionally as not absolutely necessary to my main subject. Then I could explain armature reaction in another way by describing the free poles of the field and armature surfaces and their induction of poles of opposite sign on adjacent surfaces. But I want to adhere to the simple conception of the magnetic circuit. These other effects can all be expressed as qualities of the circuit, and do not oppose its conception as I have drawn it. And, moreover, my diagram is not necessarily an imaginary one, for you can get just such a diagram, by the use of iron filings, from an actual dynamo.

Please remember when we come to examine regulation by changing the strength of field, that this armature reaction, or lengthening of the magnetic circuit, is least when the field magnetism is strong relatively to the armature and greatest when the armature magnetism is stronger than the field. I want you to notice that if the field is weakened by some external cause the armature immediately has more reactive power and weakens it still further. And please note also that if the armature polar axis is carried forward by any cause such as the displacement forward of the brushes, this change will lengthen the magnetic circuit. We are familiar in constant potential work with the rule that the lead necessary to be given the brushes depends on the displacement forward of the interfield polar axis. This rule is reversible, for the position of the axis depends on the lead given to the brushes.

The most familiar regulators of the field-changing class are those in which an adjustable resistance is connected in shunt to the field winding of a series dynamo. The adjustable resistance may be a rheostat of the conventional type, Fig. 4, with a moving contact lever, or it may be a stack of carbon plates, Fig. 5, the resistance of which will be reduced as they are pressed into more intimate contact with one another. Or it may be a trough containing liquid, Fig. 6, with electrodes which can be moved toward one another or immersed further into the liquid to get more surface contact. All of these are in everyday use. We notice that wherever they are in successful use, the variation of the resistance is controlled by a small relay in the main circuit and that the heavy mechanical work of the device is performed by magnets in a local circuit, or by the power driving the dynamo. This use of a sensitive relay is necessary to accurate regulation. It eliminates many errors, such as those due to heating of wire or carbon resistances, to polarization and change of density of a liquid resistance. The requirement for good, practical regulation of an arc circuit, is that the relay shall be more sensitive than the arc lamp.

It is frequently so delicate that it responds promptly to a variation of current of ¼ of 1 per cent.

There are dynamos widely used in which the function of the control relay is assigned to a magnet, which has also considerable mechanical work to perform, and is necessarily less sensitive as its duties are increased. Most of these dynamos obviously suffer in their regulation from that cause.

To come back to diagrams. Another way of varying field magnet strength is shown in Fig. 7. It is in use on the Hochhausen dynamo and motor, and is quite accurate when the field is divided into many sections. A similar arrangement where the field coils, instead of being altered in number, are subject to permutations and combinations that vary the number in series, is in use on two systems of series-wound street car motors. This does not work so well as the Hochhausen plan because it is limited to a few gradations, and it is usually combined with a resistance called an "easy-starting coil" to make it less jerky in its operation.

Either of these methods works first to change the ampere-

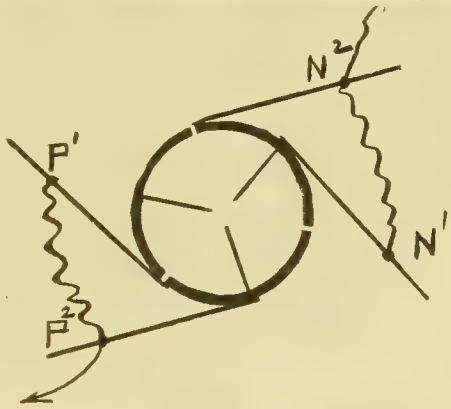


FIG. 8

turns in the field coils. The shunt arrangements change the amperes and the commutator arrangements change the turns. That means a reduction of magneto-motive force, but the magneto-motive force in the armature remains the same; its amperes and turns are constant, and so there is armature reaction. The polar axis of the interpolar area shifts forward and the brushes have to follow to stop sparking. This very carrying forward of the brushes shifts the interpolar axis still more because it shifts the armature axis; and so there actions continue till equilibrium is reached. Now we have as a result a longer magnetic circuit than before regulation began, more magnetic resistance as well as less magneto-motive force; therefore a double reduction of the magnetic flux or field strength.

Some of you may have been accustomed to think of the reduction of electromotive force under the field regulation as due only to change of exciting current. The changes of lead under such regulation should indicate the actual process to an observer, but not one published description takes account of anything but the fall of field current. If you wish to understand clearly the process, I suggest that you put an ammeter in the field circuit of your dynamo. You will possibly find a reduction of electromotive force of 90 per cent. to follow a reduction of only 45 per cent. in the exciting current.

We come now to consider that class of regulators which operates by moving the brushes of a closed coil armature. There is a marked difference in this method as applied to open coil armatures, and we will consider now only those having Gramme or Siemens windings. There are a number of dynamos in this class. Some regulate well, some miserably.

The most common explanation of this regulation is by the well-known "diagram of potentials," showing that near the neutral point the brushes are on the diameter of maximum difference of potential, and that 90 degrees distant they would find a diameter of equipotential, and of course that any desired intermediate potential difference can be had on the proper intermediate diameter. And you can, by using a voltmeter—not the brushes—get just such a diagram off any of these machines, so of course the explanation is complete. But I have harbored for a long time the wicked suspicion that this explanation didn't explain; even though it was put forward with a great big diagram to illustrate it right in this club. And this was what aroused my suspicion. I looked at the diagram and saw that if I rocked forward those brushes 45 or 50 degrees, I would get just half the maximum potential. Then I looked at a machine and found that if I rocked forward the brushes 45 or 50 degrees, I didn't get any potential at all. Then I looked at more machines, and more and more of them, and they all had this utterly unjustifiable departure from the diagram which they were bound to live up to. And so my suspicion grew.

Now I don't operate an arc machine of this kind, and so I could not apply the practical methods of investigation, but there fell into my hands lately a 400-ampere incandescent machine, which had the same characteristic of a rapid fall in voltage as the brushes were rocked forward, and the same marvelously sparkless commutator that the best of these arc machines possess. I said the best of them; they are not sparkless as a class, and some of them can eat more copper than any open coil dynamo.

So I went to work on my 400 ampere machine with a voltmeter, and I got a beautiful potential curve. Then I calculated the position which would give me 5% reduction in voltage, rocked the brushes forward, and got a 10% reduction. And so it was in every position in which I could try it.

Then I got hold of a series wound dynamo and ran it on a resistance. I rocked the brushes backward and forward as far as the spark would permit, and found that I could vary the current from maximum about 40% downward. Then I tried what effect varying the field current would have in comparison with changing the lead, and I found that variation of field current simply wasn't in it; a little change of lead would neutralize all the variation I could control.

Here were two machines that had but one thing in common with the arc dynamos: namely, a strong armature compared with their fields. And they show the same quality of regulation by brush rocking as did these special arc dynamos. My suspicion was becoming a theory at a rapid rate.

Then I bethought me once more of all the arc dynamos I had ever known that regulated in this way. I singled out two that I knew could be adjusted to a fraction of an ampere, over a long range of e. m. f. These two had Gramme armatures—the type that gives the strongest magnetic reaction. They had also fields of small value compared with the armatures. And I bethought me of two others which I knew would not regulate within 10% at low e. m f. These two had armatures of a different type which gives the least magnetic reaction, and had massive fields; in fact, had fields of a pattern which has proved admirable in controlling variation of lead in incandescence work. I remembered also that these two carried a bad spark at small loads. Also that one of them had practically been driven out of use by that spark, and that the other, which had a splendidly designed commutator and so could stand the spark, had been improved by changes tending to weaken its field.

And so I formulated the theory that regulation by brush rocking depended on armature reaction, and that consequently the essential condition to success under this method was a magnetic circuit in which the armature magnetism had large value in comparison with the fields. I will try to verify that theory when I get a good opportunity. In the meantime it is up for discussion.

Now there is one more method of constant current regulation in use, that cannot be left out of any paper on this subject. It is regulation by changing the effective length of armature conductor, and its sole representative is a well-known open coil dynamo, the Thomson-Houston. You are doubtless familiar with the brush arrangements of this peculiar machine, and know that its regulation of e. m. f. is by a device which short circuits the armature. But to assist your remembrance I have here two diagrams, showing the full load, Fig. 8, and minimum load, Fig. 9, positions of the brushes and their contact with the segments at these positions. Notice that in the minimum position the armature is absolutely short circuited from brush to brush during half the revolution. That is, it is short circuited six times in each revolution and each time during 40 degrees of its movement, a total of 180 degrees. This period of short circuit is gradually reduced in its duration, although it still occurs six times per revolution, until the full load position is reached, when it is almost nothing. It would

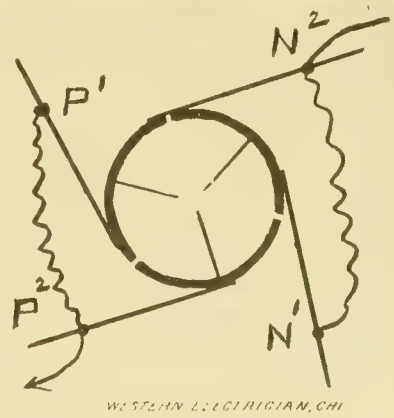


FIG. 9

be absolutely nothing if it were not for the spark. The metallic contact is broken, but the spark under the tip of the secondary brush has conductivity, like any other electric spark, and so gives a momentary short circuit.

I have defined this regulation as changing the effective length of armature conductor and you see the reason of the definition. Of course the actual length of armature conductor is unchanged but the effective length is, in virtue of the fact that the armature conductor is closed on itself and forms a local circuit by itself, having no connection with the circuit under regulation.

A similar method is applicable to any open coil machine

which "cuts off" the coils passing the neutral point. If an active coil be thrown into parallel with an idle coil, the two form a local circuit and are so removed, from the circuit under regulation. This method is somewhat unmanageable as a device for adjusting output to load, but can be and is employed to get special results in the design of open coil commutators.

How to consider the internal process of regulation in the dynamo which short circuits its armature.

The actions following the short circuit of active armature coils are complex. We expect the most noticeable to be the development of a tremendous current in the short circuited coils, with great heating, and our experience with short circuiting of individual sections of armatures would lead us to predict the early destruction of the winding from this cause. And that is just what many electricians do predict. The facts do not bear out the predictions.

This armature, though not noted for exceptional long life, makes a very good showing in that respect, and its burning out when it does occur is not attributable to the excessive heating of its windings under regulation.

The enormous short circuit current begins to develop but meets reactions which arrest its growth. To consider these; a short circuit occurs six times in a revolution. That means in a dynamo running at 800 revolutions, that this abnormal current is started and arrested 4,800 times per minute. In other words, that it is a periodical current with a periodicity of 80. This periodical current is developed in two coils of great length; of many convolutions; wound on an iron core; in other words in a circuit of great inductance, and so being subject to the laws that govern periodical currents in inductive circuits—just the same laws that govern alternating currents in converters—it attains a very small mean value and has proportionally small heating effect.

If we stop the consideration of the subject here, we could understand that the coils so short circuited, would be little more likely to heat, than if carrying only the regular current; but there are further reactions to be considered, to understand the operation of the regulating device. There is a direct reduction of the field of force, due to the cutting off of the exciting current by the short circuit at the brushes. The armature is closed on itself and sends no current to the field coils, and this cessation of magneto-motive force implies a cessation of magnetic flux—"a loss of field." The field grows gradually, returning its accumulated energy to the circuit which supplied it in the shape of an "extra current" in the same direction as the exciting current, and this extra current passing to line occupies the time between armature currents and makes the line current continuous. It is undulatory—not intermittent, as it would be but for the discharge of the field magnets. The process is reversed when the short circuit is removed from the armature. The armature current has risen above normal, and carried up the armature magnetism with it. This accumulated energy would pass to line as a sudden extra current, but is retarded by the partially discharged field magnets and expends itself in carrying their magnetism up toward its normal value. This is a good example of the "steadying effect" of a magnet on a pulsatory or intermittent current. And there is still another cause reducing the induction. We have seen that there is a slight increase in the armature magnetism and also a decrease in the field magnetism. That means that the equilibrium of polarity established between the armature and field in their normal relation, is now disturbed. We have outward evidence of this in the necessity for moving forward the secondary brush of each pair in order to minimize sparking—the lead has obviously changed.

We observe that the designers of the dynamo found it well to introduce some complication on this account. They move both brushes of each pair and these in opposite directions, and for different angular distances. The short circuiting for regulation could have been accomplished just as well by the rocking backward of the primary brush, but change of lead results therefrom and so to keep on the point of least spark the secondary brush has to go forward. And we have seen earlier in this paper that any forward change of lead signifies a lengthening of the magnetic circuit, and a consequent reduction of the field value. Thus the regulation is affected not only by removal from circuit of the conductors cutting lines of force, but also by actual reduction of the number of lines of force in the field. And further we see that this reduction of field is due both to a decrease in magneto-motive force, in that the exciting current becomes intermittent; and to increased resistance of magnetic circuit in that the resultant polarity of the armature is displaced forward, virtually lengthening the path to be taken by the magnetic flux.

The same reduction of field that affects the working circuit influences also the local circuit of the armature and aids in preventing any injurious increase of current or heating of the short circuited coils.

It will be asked why the operators of these dynamos avoid running them on few lamps and what cause there is for the frequent statement that they heat when worked on a minimum load.

The explanation is simple, if we again consider the action of periodical or intermittent currents.

We observe that as the load decreases the short circuiting becomes more lengthened, and the currents delivered to the field coils become more markedly intermittent. These coils are wound on an iron core, and it is to the iron we must look for the heating. It is in exactly the same relation to the field coils as are the secondary winding and iron core of an induction coil to its primary, and it is not laminated as is the core of the induction coil, nor is it, like the secondary, provided with an external circuit for the utilization in external work of the currents developed in it. It is to these induced or Foucault currents that we must attribute the heating of the dynamo at short loads.

My experience with this machine is that the heating seldom becomes objectionable in practice.

If it were necessary to eliminate it, lamination of fields and an additional lamination of armature would be the obvious remedy.

I am not sure, though, that the cure would not be worse than the disease

The last point I can take up in this paper is the influence which the work a dynamo is doing has upon its regulation. Of course the work of a dynamo can be expressed as so many watts, no matter how the current is employed, but practical men recognize that certain classes of work, though they may not exceed in watts certain other classes, are much more severe on the machine and trying to the regulation. I have spoken of the difficulty of regulating with series motors on a constant current dynamo. That is the meanest work you can put a machine to, and the fact that so many lighting stations have developed a paying and satisfactory business in supplying current to such motors is a big compliment to American electric light men. Just think of the changes a dynamo has to meet when it is in circuit with a motor which occasionally holds up a runaway by backing its brushes and acting as a generator.

The motor circuit is notoriously the hard one; but many practical men have noted that there is difference in facility of regulation with different arc lamps in circuit. Thus the differentially wound arc lamp, with a strong magnet in the main circuit, is an easy lamp to regulate for. The discharge from the series magnet helps the dynamo during a momentary overload, and so does the shortening of the arc. But the shunt wound arc lamp—the so called "open circuit" lamp is just the reverse. The discharge from its magnet goes through its own arc and for all small changes of current its action is to lengthen the arc for a decrease and shorten it for an increase, and so put more work on the dynamo regulator. The series incandescent lamps behave in a similar way. A circuit with a large proportion of these is always hard to pull. For instance the machine flashes and loses its field. If only arc lamps were in circuit they would drop to the idle position and the dynamo would practically be short circuited and build up its field again at once. But the incandescent lamps get time to cool and their resistance increases so much that the dynamo has a circuit badly adapted for quick building up. I have seen it necessary to cut out the loop containing the series lamps in order to get a field quickly, although the dynamo picked them up at once when they were switched in after the arcs had lighted.

In concluding I would suggest to you the adoption in your studies of the expression I have used for the armature reaction effect; namely, lengthening of the magnetic circuit. I submit that the expression has the following advantages: It explains the observed effect; it conforms to the now generally received law of the magnetic circuit; it can be expressed in terms of magnetic resistance, just as can the effect of any other change of magnetic circuit; it admits readily of graphic illustration; and can be shown by an iron filing card taken from an actual dynamo.

The terms armature reaction and cross magnetization don't fit with the idea of the magnetic circuit. The expression of the effect as so many negative ampere turns has been employed, but it is confusing to consider a condition as a reduction of magneto-motive force when that theoretical condition is accompanied by an actual increase of ampere turns. I propose to count all ampere turns of field and armature as positive, and to express the reduced magnetic flux following distortion of field as due to increased length and therefore resistance of the magnetic circuit.

Inductive Disturbances in Telephone Circuits.

At the conclusion of J. J. Carty's paper on "Inductive Disturbances on Telephone Circuits", read before the American Institute of Electrical Engineers, and published in the WESTERN ELECTRICIAN March 21, this discussion took place:

A. E. KENNELLY: I have endeavored to obtain some quantitative notion of how much electrostatic disturbance and how much electromagnetic disturbance would take place in Mr. Carty's Fig. 2, by assuming certain definite quantitative relations between those circuits. We suppose that L^1 and L^2 are half an inch apart, and all wires are No. 12 B.& S. gauge copper, also that L^3 is so far remote that its inductive influence on the others and the influence of the others upon it, may be omitted from the calculation. Then it is easy to find out how much electrostatic induction there would be, supposing electromagnetic action absent, and how much electromagnetic action takes place between the two, supposing electrostatic disturbance did not take place. To avoid very great complexities which would take long to follow out to their ultimate consequences, that perhaps is a fair comparison. Under those circumstances, supposing that electrostatic influence existed alone and then afterward electromagnetic influence existed alone, with four telephones in the secondary circuit, whose resistance, we might suppose, would be 75 ohms each, and whose inductance might be 90 milli-henrys apiece, then if the primary circuit had a periodic electromotive force acting upon it, such as would correspond for example to the note A sounded in the telephone at 400, or more accurately 435 periods per second it would be necessary to insert an impedance in the primary circuit equal to 400 ohms in order to have electromagnetic action equal to electrostatic action. The fact Mr. Carty has mentioned, that the impedance of the receiving instrument of the primary circuit was high, leads us to suppose that this impedance was much greater, probably ten times as great, and would bear out his statement from the theoretical point of view, that the effect of electromagnetic disturbance is virtually null compared with electrostatic disturbance under those conditions. But it would be desirable if Mr. Carty could give us an idea as to how far reducing the impedance in the receiving end disturbed the neutral point and so gave indications of a tendency to equality between the two disturbances.

MR CARTY: I go so far as to set forth that the effect of electromagnetic induction between parallel telephone wires may be neglected. That is, that when a man is talking on one wire and his speech is heard by induction on a parallel wire, that that speech finds its way between the two wires by virtue of electrostratic induction, and that electro-magnetic induction is entirely negligible. I would like to describe a few experiments to prove that; and if they do not prove it I shall be very glad to have that fact pointed out.

I will now show what I consider the most favorable condition for creating electro-magnetic induction between two telephone wires. That (indicating T Fig. 12) represents the coil of a long distance transmitter sending the most powerful telephone current that it is now possible to generate. L^1 represents the wire connected to earth. It may be, we will say, 200 feet long. Parallel to it and an eighth of an inch away, we will place another telephone circuit. These wires may have an insulation of 10,000 megohms and the resistance might be considered as one ohm. Now a cur-

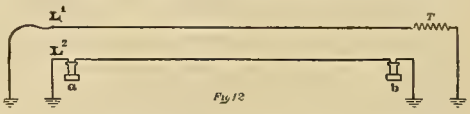


Fig 12

rent resulting from a given note in the transmitter through the wire L^1 produces a series of changes in the magnetic field surrounding it, and that action is roughly explained by assuming that the current starting in L^1 induces a current in L^2 in the opposite direction, and that the induced current will flow through both telephones a and b. Now, it is a fact that under those conditions absolutely no sound is heard in telephones a or b.

Now I will describe an experiment which I made with those same wires. We will open the wire L^1, Fig. 13 at the far end. Then when the transmitter is operated, noise is immediately heard at the telephones a and b, located at the ends of the secondary wire, and if a telephone, c, be located at the exact center of impedance it will be found to be silent. When the wire L^1 is opened at the far end we have the maximum electrostatic and the minimum electro-

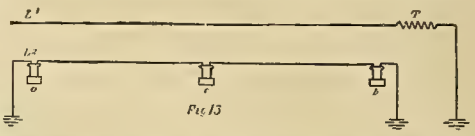


Fig 13

magnetic action, When it is closed we have the maximum electro magnetic action and the minimum electrostatic action. The reason that the electrostatic action is slight in Fig. 12 can be seen from Fig. 14. Assuming that the m n represent the height of potential of the transmitter, the resistance of the circuit is mostly in the transmitter and the fall of potential therein is very sudden. At any point along the wire L^1 the potential would be practically zero, as shown by the dotted line o p.

I wish to show another experiment in proof of the fact, or what I think is a fact, that electro magnetic induction is negligible when we consider the action that goes on between two telephone circuits. I expressly limit the statement to the action between telephone circuits, and I am not discussing disturbances in general but merely inductive cross-talk. Now, I will draw a line—L^2—Fig. 15, similar to the one I used before, and we will assume that

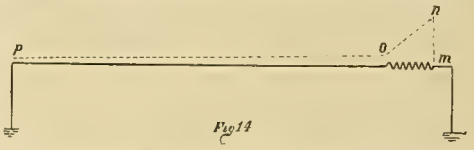


Fig 14

the circuit is completed by a return wire of no resistance, or of very low resistance, entirely outside of the field of disturbance, so as to eliminate all questions of leakage through the earth. We will say that L^1 is grounded on a gas pipe. We then have the disturbing wire as before, and when the transmitter is operated loud tones are heard at the end telephones, a and b thus: If this were entirely due to the creation of an electro-magnetic field around the disturbing wire, the effect on the secondary wire would be increased by short-circuiting one of the telephones by the key k. Now, it is found that when this is done, instead of increasing the sound in the other telephone, it absolutely removes it. Now, the case just described is another condition where you should get an increase of electro-magnetic action, if the disturbance is due to the magnetic field, but the noise, instead of increasing, disappears en-

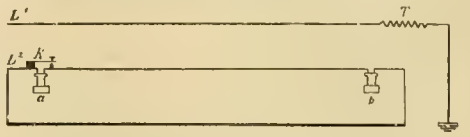


Fig 15

tirely. Now, you will see how beautifully the thing may be explained by assuming that the disturbance is due to direct electrostatic action. In this case we will say that the wire L^1, at a given instant, has a plus charge upon it which induces a minus charge on L^2. Now, when the inducing charge is removed the induced charge divides and flows away at both ends. But as there is a great deal of resistance in telephone b, and practically no resistance in key k, the charge and discharge of L^2 takes place up and down through the key end and none of it goes through the telephone b. Now, I think that is a complete refutation of the statement that any portion of the noise produced in the telephone is due to electro-magnetic action. There is no doubt that when the current is going through L^1, in the act of charging it, that there is a magnetic field surrounding that current, but I have shown that it is so feeble that it does not

produce any effect in the telephone; that is, the action that is due to the electro-magnetic field is so feeble that the ear is not able to tell whether it is present or not.

I wish to point out that there must be some mistake in the reference given by Mr. Lockwood in his note. He says: "Mr. Culley presented a paper once upon this subject before the Society of Telegraph Engineers, which paper, together with a most instructive discussion, is published in the journal of that society, and Mr. Preece and myself from time to time have also repeatedly referred to it." Mr. Culley has not read a paper of any kind before the Society of Telegraph Engineers or Electrical Engineers since 1875. That was before the invention of the telephone. Mr. Culley's paper of 1875 dealt with the induction of telegraph wires. I put in a foot note referring to Mr. Culley's paper in my Electric club paper. I think that must be what Mr. Lockwood means.

High Potentials.

In the last issue of the WESTERN ELECTRICIAN an illustrated article on "Experiments with High Tension Currents at the Oerlikon Works, Switzerland," was presented. These experiments were made by C. E. L. Brown. Following is an abstract of Mr. Brown's paper on this subject:

Of course, it is unnecessary for me to recapitulate the laws governing the relation between size of conductors, loss and electromotive force. A simple calculation shows us that with unlimited electromotive force we may transmit enormous amounts of energy through very thin wires at very small losses over the longest distances.

But here, as in all other problems, we are met by practical limits which command us to stop. These limits are determined in the present case by the following questions:

Which is the highest potential which can be generated in practice in a sufficiently safe apparatus?

Which is the highest potential which we may convey at long distances with the means we have now in possession?

And to what degree can we protect ourselves against the dangerous effects of high tension electric currents?

Until the present time, potentials of two thousand, three thousand and perhaps four thousand volts were the highest used in practice. My long experience in electrical power transmission, however, and the still growing magnitude of the projects which came before me, proved to me that we had not reached the utmost limit of possible attainments if we intended to assist electricity to a complete victory. Hence my endeavors for the last few years were directed toward the application of still higher potentials, and, of course, the first question that presented itself was how can high potentials be generated in the most rational manner.

If we consider first our ordinary direct current dynamo, we find the limit of practical possibility very soon. The arrangement of the wires on the armature, the necessity of the commutator make the construction of this type of machine for very high tension exceedingly difficult, at least with the insulating materials known to us at the present day. I constructed direct current dynamos of 2,000 and 2,500 volts, which have been running continuously day and night, without difficulty, but their construction showed me that higher potentials with such dynamos are obtainable but necessitate proportions, especially between insulating material and copper, which would produce a dynamo of a size that would not be economical These proportions are decidedly more favorable in alternating current machines furnishing high potential currents.

The separate divisions of the armature winding, each of which generate only a fraction of the total potential, the absence of a commutator and the possibility of making the armature stationary and rotate the field, make the alternating current dynamo more fit for the generation of high potential currents.

As the principal illustration of this class of machine, we can refer to the huge Ferranti dynamos, in which each two coils of the armature form a complete unit in themselves insulated from the core of the armature. Hard rubber boxes are slipped over the magnet cores and coils.

The application of such an excellent insulation is possible, of course, only in very large dynamos, because the insulating material preponderates over the amount of the working copper.

In all dynamos for the direct generation of high tension currents, no matter how perfectly constructed, there is one disadvantage, viz, when the machine is running the handling of certain parts is attended by danger, both in relation to the machine and the dynamo tender. Hence the most ideal apparatus for our purpose is without a question one which is absolutely stationary, which does not require any tending and which is so constructed that without even touching it, it may be left for years in service.

This leads us naturally to the alternating current transformer. I suppose that the principles of the transformer are well known to you, and I will confine myself to giving you my ideas on the practical construction of transformers for very high tension. A transformer should be so constructed that it can be easily taken apart. This makes it necessary to construct separate primary and secondary coils, which are separated from each other and from the iron.

The construction of the coils should be such that any common workman can wind them on a lathe, in order to eliminate the elements of expert labor for repairs.

The insulation between the two coils and against the iron should be such that a short circuit between the coils, or a contact with the iron, be made impossible, and finally the whole arrangement should be such that the apparatus may be erected in any place and under all conditions without any danger whatsoever.

A transformer built on these principles will be an ideal, safe apparatus, and from my experience in the machine works at Oerlikon I may say that such a construction is possible.

We have now the conditions for the construction of the transformer for a potential of say from two to three thousand volts and may be a little above, but not by any means for potentials of 20,000, 30,000 or 40,000 volts.

Even if a transformer, just gotten out of the workshop, should be able to stand such high potential, the influence of the atmosphere during its practical operation will soon short-circuit it. Here now we must introduce a new factor, viz: The oil as insulating material.

Oil is known to be one of the best non-conductors of electricity. It has the property of filling all pores of insulating materials, as cotton, linen, paper, etc., and excluding air and moisture. Oil is therefore capable of insulating against the influence of the atmosphere.

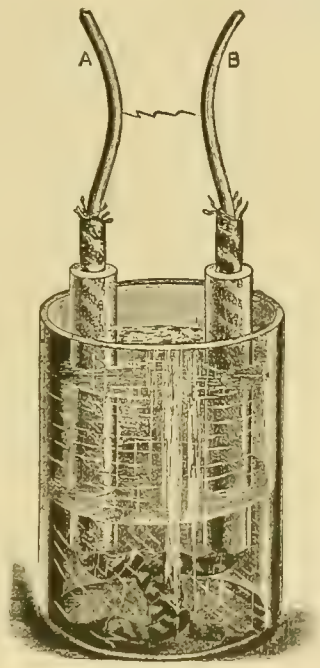
A well-known experiment best demonstrates these facts. In the accompanying cut is shown two cotton braided wires, the ends of which are twisted and put in a glass filled with a thick resinous oil of higher specific gravity than water and heated for a few hours in order to expel all water and air out of the cotton and the oil. Over the wires are slipped two glass tubes which extend above the surface of the oil. A small quantity of water is then poured on the oil. If we now connect the upper ends of the wires to the poles of a Rhumkorff induction coil or a frictional machine, we can obtain sparks between these wires a few inches in length without puncturing the cotton insulation submerged in the oil.

This is without any doubt a proof of the highly insulating properties of certain oils.

The first application of oil for this purpose was made probably by Brooks in his underground conduits. He drew common cotton insulated wires through pipes and then filled them with oil.

The application of oil as insulating material for transformers carrying a very high potential was first proposed by me. In my experiments I put the whole transformer in a cast iron box, which I then filled with oil and which I kept heated for hours to a temperature of 150 degrees centigrade. Through this process we obtain the following advantages:

The oil fills and penetrates all pores and fissures of the apparatus, entirely displacing air and moisture and covering the whole transformer. The possibility of puncturing the insulation is, of course, greatly diminished, and the transformer protected against influences from exterior sources, as atmosphere, dust, etc.



HIGH POTENTIALS.

The apparatus exposes against these influences nothing but a surface of oil, and the fact that the oil remains a compact mass, makes it very much more fit for this purpose than paraffin, for instance, which will crack and absorb moisture through the fissures.

Of course, it is necessary to construct an insulating transformer in the very best manner possible to commence with, and not depend upon the oil insulation solely.

The coil for the low tension current is generally very simple for the reason that for the generation of a potential of say 30 000 volts, by means of a transformer, we use a generator of say 20, 30 or 50 volts only, and therefore the primary coil of a transformer will consist of a few turns of thick wire only. Insulation can be easily obtained.

The first transformers constructed in this manner were transformers used in the Oerlikon experiments. I could use them immediately after they had been finished for a potential of 40,000 volts without the least difficulty. (WESTERN ELECTRICIAN, April 4, 1891, page 193, "Experiments with High Tension Currents at the Oerlikon Works, Switzerland.")

For conveying extreme high tension currents only the overhead system can be practically considered, and it is possible to construct an overhead line in such a manner that even with the highest voltages there will be practically no leakage.

The points of support or the insulators, of course, are the points which must be of highly insulating properties to prevent leakage.

The glass or porcelain insulators which are now in common use are very good insulators only when they are perfectly clean, and when the atmosphere is dry. In moist atmosphere the insulator will be covered with a film of moisture outside and inside, and this film will allow considerable surface leakage.

This consideration led Johnson & Phillips of London to the construction of their fluid insulators. These insulators are made of porcelain or brownware, and are provided on the inside with a trough containing oil.

The oil used for this purpose is thin and of a low specific gravity in order to allow the water to sink to the bottom of the oil.

If any condensation of moisture takes place now, it does not form a film over the whole surface of the oil, but it accumulates in little drops which have no connection with each other, and which will sink to the bottom of the trough just as soon as they have grown to a certain size.

We must not imagine that the oil will be displaced by the water in a very short time, because the amount of moisture which is condensed under the bell of an insulator is very little during a year, and it will take at least two or three years before the insulators would need refilling with oil.

The insulating properties of these fluid insulators are extremely high.

Prof H. F. Weber in Zurich made some experiments in 1887 on the conductors put up for a long distance transmission plant (Kriegstetten-Solothurn). The conductors had a total length of 24 kilometers and were fastened to fluid insulators.

Prof. Weber could not detect any leakage, even with a current of 2,000 volts passing through the wire. The insulation of the line was absolutely perfect.

For the conveyance of currents of say 20,000 or 30,000 volts, however, even these insulators would not be quite sufficient. Combinations, however, as shown in the WESTERN ELECTRICIAN of April 4, page 193, would multiply the insulating effect to any desired degree.

These insulators could be easily protected against the malicious throwing of stones or other destruction by providing them with a bell-shaped iron cover.

The objection might be made that such insulators would need constant attention, as they must be cleaned and refilled with oil at certain periods. This, however, does not seem a great disadvantage, for the reason that the fastening of wires carrying such high potentials should be inspected any way from time to time.

At any rate, these considerations will show that one of the objections made to the transmission of high potential currents, viz., the enormous leakage, does not hold good, as even with the highest potentials good line construction will prevent practically any leakage.

Lightning arresters, of course, must be applied, not only to each end of the line, but at certain distances between the power and motor station. These lightning arresters must be automatic so that they will extinguish an arc in case it should be set up. Such an automatic lightning arrester can, for instance, be constructed by having the lightning pass over two carbon plates which are separated by a small distance, and which are automatically drawn from each other by the dynamo current, thus extinguishing the arc; after this has has taken place, of course, the plates should automatically return to their former position.

I believe I have briefly mentioned all factors which have any bearing on such an installation. There is one point, however, which should be mentioned, the possible loss of current through the air. Nothing certain has been determined on this point. We will probably learn within the next few months whether this loss is an important factor in long lines and at certain high potentials. At any rate, the danger of such a loss is much smaller than has been assumed heretofore.

Under no circumstances whatsoever will high tension currents be utilized direct, nor will they be introduced into the houses of the consumers. The conditions will generally demand that the current be reconverted not only once but twice. If, for instance, we transmit a current of 30,000 volts, it would be reduced in a transformer station, which should be situated as one of our present central stations, to say about 1000 or 2000 volts. This voltage would then be sub-distributed to the consumers or a sub transformer station, in which the current would be again reduced by means of transformers to say 100 or 200 volts.

This whole arrangement from the primary station to the consumer may appear a little complicated at first sight; it will appear economical, however, in relation to efficiency and first cost of installation. If we consider such an installation a little closer, we find first that the generators for low potentials can be built much cheaper than those for high potentials, so that the difference between the two would pay for the additional primary transformer.

The commercial efficiency of dynamos of lower potential is higher than that of dynamos of high potential; this results in the fact that the combination of a low potential dynamo and a transformer is only from 1 to 2 per cent. less efficient than a high potential dynamo without a transformer.

The main advantage obtained through the application of so high a potential is the great reduction of the weight of the conductor and of the loss in the same; the additional cost for transformers and the loss in transformers will be more than overbalanced. A simple example will prove this:

Let us assume we have 500 horse power to transmit at a distance of 20 kilometers, and employ in one case a potential of 5,000 volts direct and 10 per cent. loss in the conductors, and in the other case 30,000 volts with transformers and 3 per cent. loss in the conductors.

In the first case we would require a copper conductor of 90 sq. millimeters and in the second case only 9 sq. millimeters. This would result in the first case in a weight of copper wire of 32 tons, and in the latter case of about 3.2 tons. The weight of copper in the second case will therefore be only 1.; although the potential of 5,000 volts, as assumed for the first case, is certainly very high.

Through the saving in copper the additional cost of transformers, of course, will be more than covered.

Now let us consider this matter relating to the commercial efficiency:

The efficiency of a dynamo of 500 horse power at 5,000 volts can be assumed as 92 per cent. If we add the loss in the conductor at 10 per cent. (90 per cent. efficiency of the line) we get at the end of our conductor an efficiency of almost 83 per cent.

In the second case the efficiency of the primary dynamo and transformer may be assumed as 90 per cent. and the efficiency of the conductor as 97 per cent., and of the secondary transformer as 97 per cent. Hence we get a total commercial efficiency of over 84 per cent. Besides we have the additional advantage that in the second case this 84 per cent. can be obtained at any desirable voltage, while the 83 per cent. in the first case is delivered at an inconvenient potential of 4,500 volts which probably could not be used direct and would have to be transformed to a lower potential.

This shows clearly that the second case is more economical in spite of the fact that the current must be converted and re-converted oftener.

I should like to mention that this idea of first converting alternating currents of low potential into high potential and then re-converting into low potential is not new by any means. A project of this kind was proposed by me to the city of Naples, Italy, as early as 1886, and my intentions were then to use 10,000 volts in the conductors.

The special purpose for which a transmission plant is to be erected, of course will greatly influence the selection of the transmission system.

I should like to state that the experiments which I conducted for the Oerlikon works, and which have been described in this paper, became public property for the following reason:

It was the intention of the Oerlikon works to transmit electrical energy in the manner described on the occasion of the Electrical Exhibition at Frankfort-on-the-Main; the line was to be erected from Lauffen to Frankfort. The governments of the adjoining states made their permission for this installation depending upon preliminary experiments in which we had to demonstrate the possibility of utilizing very high tension currents, by means of overhead conductors, in a safe manner. I think the construction of such transmission plants on the basis of my preliminary experiments entirely feasible, although a good many problems in this connection must be solved yet.

The Electrical Utilization of Water Power.[1]

By Madison Buell.

The electric transmission of power by means of the earth's rotary motion, through the immense tidal energy all over the world is destined to become of far more importance than the combined influence of the steam engine, the telegraph, the telephone and the electric light. It will be the means of furnishing a large portion of mankind with all the power, heat and light required.

Nor will this be all. While the water wheels will be turned by the rotation of the earth, through tidal energy, the effects of such arrangement are remarkably different from the arrangement of wheels to be turned by mountain streams, rapid rivers, and cataracts like Niagara. The one obtains its living force from the rotary motion of the earth, and the other from the ethereal vibrations of the sun producing radiation.

The combination of these two forces will eventually crowd out the steam engine, and in order that the latter may be able to compete with them, the coal which is the great source of energy for that mechanical apparatus instead of being distributed at great expense over a vast amount of territory, will have to be burned at the pit's mouth, and its power electrically transformed.

The energy of the tidal wave, the rapid river, and mighty cataracts transformed into electrical energy, is a branch of the electrical scieace, that is going to revolutionize the in dustries of the world.

It is a grand conception—this transmission of electrical energy to great distances—this whirling of the mighty armatures of immense dynamos by means of the rotary motion of the earth and the ethereal vibrations of the sun.

Scientists have estimated that the ethereal vibrations of the sun alone for the space of sixty seconds, upon the earth's surface is equal in mechanical work to over 180 billions of horse power. But who has ever estimated the available water power of the world?

The grand and sublime spectacle of the cataract of Niagara shows a tremendous energy. Over 21,446,210 cubic feet of water pass over every minute, but it is only infinitesimal in comparison with the grand total of the whole world.

"All objects lose by too familiar a view," and perhaps if we look elsewhere we can get a more realistic idea of the magnitude of the tremendous energy nature displays.

A bird's eye view will reveal nine principal rivers flowing into the ocean, with a daily discharge of 1,500,000,000 cubic feet of water every minute. The weight of this water in round numbers is 300,000 tons, and on an average every ton has fallen 3,000 feet before being absorbed by the Pacific. This mass of water exerts every time it descends one foot, 300,000-horse power, or the grand total of the nine rivers, every minute is equal to 900,000,000 horse power.

These are the forces when completely utilized by the electrical engineer for the general advancement of the human race that will eventually supplant steam.

This statement is a broad one, and to show you its full signifiance let me give you an idea of what a gigantic revolution the two forces named will have to accomplish in order to do so.

Four-fifths of the working machinery of the world has been built during the last twenty-five years. The United States has engines representing 7,500,000-horse power; England 7,000,000; Germany 4,500,000; France 3,000,000; and Austria-Hungary 1,500,000. These figures are exclusive of the power represented by locomotives, which number in the whole world 105,000, equal to 3,000,000-horse power. Add this to the other motive power and it will be found that we have on this globe engines equal to 46 000,000-horse power.

Let us go still further. A horse power is equal to the power exerted by three live horses, while a working horse has the power of seven men. The steam power of the world therefore does the work of a thousand million men or twice the number of the working population of the earth.

This globe has a population of 1,445,923,000. Steam then may be said to have trebled the human working power.

Let us swing our ethereal camera slowly around the world, taking such views as will slightly show how far such a revolution as I have predicted has already progressed.

Our camera, after one or two revolutions, has finally settled with its huge lens pointing directly toward Switzerland, Italy, and the Scandinavian peninsula. This action seems almost to be a prophetic one. It is predicted that within the lifetime of persons now living the industrial supremacy of Great Britain will pass away with the exhaustion of her coal fields, unless the conception of the transmission and distribution of electrical energy by means of water power becomes an accomplished fact.

The prophetic action of the ethereal camera indicates that the countries named will become the great distributing points for the transmission of electrical energy by means of the inexhaustible and permanent water power now running to waste.

It shows that the ethereal vibrations of the sun are melting the Alpine snows, and the water in a never falling stream is revolving the turbine wheels, which whirl the dynamo's armature, and its electrical energy is conveyed miles away over a copper thread to a motor of a woolen manufactory of over 36,000 spindles.

Another movement of the camera, another pressure of the "button" and we have another negative, showing hundreds of laborers erecting a large plant at Rheinfelder on the Rhine, consisting of twenty turbine wheels coupled direct to dynamos of 500,000 watts. The energy is to be transmitted to various industrial centers within a radius of fifteen miles.

Here is one showing a recent achievement in modern engineering, in an electric mountain railway at Burgenstock, near Luzerne, Switzerland. The Burgenstock is almost perpendicular; from the shore of Lake Luzerne it is 1,330 feet, and it is 2 800 feet above the level of the sea. The total length of the road is nearly a mile, operated by two dynamos of 25 horse-power worked by a water-wheel of 125 horse-power.

The next negative shows a peculiar view between Pazzala and Lugano, in Italy. We see a large waterfall, which supplies the water conductor through iron pipes to the dynamo room, where two Girard turbines of 300 horse-power each run two dynamos, one for continuous and the other for alternating currents, the former working the tramway motors, the latter supplying nearly 2000 16 candle-power lamps at the hotel, and in private buildings.

Here is a picture of the town of Trente, Austria. A large waterfall furnishes the power sufficient to supply electrical energy to all the mills, hotels and small industries; it also furnishes to the houses of the poorest inhabitants of the town not only power, but illumination.

The next view is an Irish scene of the Giant's Causeway Electric Railway in the North of Ireland, showing two Alcott turbines driving dynamos which furnish power for the motors of the railway; the latter is eight miles long.

I find nearly 200 electrical power stations in Switzerland operated by water-power, and it would be too tedious to give full descriptions of each one, especially so, when I desire to take hurried views all over the world.

The next is an interior view of an office in London, Eng. There is a large table around which are gathered a group of men anxiously and intently engaged in examining a large diagram of machinery and outlines of watar courses and cataracts. The men evidently represent a syndicate of English capitalists and electrical engineers.

I can read these words on the diagram: "The waste forces of nature;" "The waterfalls of Wales may be utilized in London;" "The torrents of the Highlands may work tramways and supply power and light in Edinburg;" "The wasted horse-power of Niagara may light up New York."

The next picture represents a hotel, "The Bernina" at Samaden, Switzerland. It is lighted by electricity, the power being supplied by a waterfall some distance away. As the power is not required during the day for illumination, the current is utilized for cooking by heating German silver resistance coils. The cooking operations for the hotel are all satisfactorily performed by this method.

I will say that it is a well known fact that Switzerland is disadvantageously situated as a manufacturing country. Although it is supplied with an almost unlimited number of the finest water-powers in the world, situated upon unfailing streams fed by the melting of Alpine snows, yet these are located in inaccessible valleys and ravines where economical transportation of heavy products is impossible. Railroad lines are in the main valleys at too great a distance from the water-powers to render them of much value. Steam power is expensive as there are no coal mines, and the coal must be brought many hundred miles over heavy grades. This is so costly that the Swiss manufacturers have been unable to compete with those more favorably situated in countries in closer proximity to the iron and coal districts. Switzerland's industries heretofore have on this account been confined to the lighter and more delicate varieties.

"The recent introduction of methods of transporting and distributing power by electricity is rapidly changing this state of affairs, and in a few years Switzerland will become one of the foremost countries of Europe" in all grades of heavy machinery.

Even on the "dark continent" the electrical energy sheds its ethereal light. At the Forbes Reef Gold Mining company of Transvaal, South Africa, the primal source of power is a waterfall three miles from the mine, operating Pelton water wheels coupled direct to Edison dynamos, each dynamo having a capacity of 67 horse-power.

Over 200 horse-power is transmitted a distance of four miles The efficiency of the entire system from the Pelton wheel pulleys to the mining machine at the distant end is over 70 per cent. That is, over 70 per cent. of the energy delivered from the water wheel pulleys at the power station is given off at the motor pulleys for work. The Kimberly mines are also lighted and worked in the same manner.

Selecting another plate, the scene is changed to Oregon. We have a splendid view of the falls of Willamette. The energy of the falls of Willamette, is converted into electrical energy and transmitted a distance of twelve miles to Portland. The city is lighted by over 6,000 incandescent and 200 arc lamps.

A view in South America shows a cataract of the Juncalillo river, having a fall of 600 feet, supplying water through steel pipes a mile to Juncal station, where it sets in motion 10 water wheels each of 80 horse-power connected to dynamos, the energy of which is used in driving motors for boring through the Andes mountains to provide for a new railway connecting the Argentine Republic with Chili.

Now we have a view of Coronado Beach, Cal., where they are endeavoring to utilize the rotatry motion of the earth by converting the waves of the ocean into the motive power. The energy is transmitted through a cable, and experiments have demonstrated the entire practicability of the scheme.

This is a tunnel 16 feet by 12 feet and 2 1-2 miles long cut through the mountain from Feather River to Big Bend, Tunnel Camp, Butte county, California. A permanent dam built across the river just below the head of the tunnel diverts the whole stream into the tunnel, and a canal two miles long, extending from the other end of the tunnel, gives a fall of 300 feet, turning powerful Pelton water wheels driving Edison dynamos. The working electric motore force is 1000 volts; the conductors are double metallic, and extend eighteen miles, delivering electrical energy at fourteen points in the circuit, where power is required for winding, pumping, etc. From ten to twenty Sprague motors varying from 5 to 50 horse-power are worked by branch conductors from these various stations; the potentials varying at the motors are from 500 to 700 volts.

Steam in the Nevada mountains is expensive on account of the scarcity of fuel; water is also an expensive commodity, as in this case we see that it is brought from the summit of the Sierras, in pipes, a distance of thirty miles to the Comstock mines.

The Sutro tunnel at this place affords an outlet for this water 1,700 feet below the surface of the earth.

Six Pelton water wheels are used for running the dynamos in a rocky chamber in the tunnel. From the dynamo room, wires are carried up to the motor room at the top of the shaft, there being a mile in each circuit.

The water wheels attached to the dynamos are 40 inches in diameter and run at 900 revolutions. They are made of phosphor-bronze in order to stand the enormous speed the velocity of the water would give them, when running without load, which would be 1600 revolutions, giving the periphery of the wheel a speed of 18,864 feet, or more than 3 1-2 miles a minute, the water flowing from the nozzle at a volicity of 19,260 feet a minute.

In a thriving town of 7,000 inhabitants, Aspen, Colo., eight Pelton water-wheels running 1,000 revolutions, under a head of 820 feet, with a maximum capacity of 175 horse-power each, aggregating some 1,400 horse power revolve the armatures of as many dynamos, furnishing the current for 120 arc lights of 2,000 c. p. each and 2,000 16 c. p. incandescent lights. These lights are distributed over an area of over four square miles, and are used for lighting the streets of the town, hotels, stores and residences.

Greenwood Springs is also in a blaze of electric light. Mills, pumps, hoists and tramways are successfully run miles away from the power station, During the winter months the Pelton wheels, though incased in ice for weeks together, keep spinning away without cessation.

In Japan there are five water wheels, having a capacity of nearly 600 horse-power, running dynamos; the electrical energy being transmitted to the city of Kioto, for general manufacturing purposes. The water is conveyed to the wheels through 2,000 feet of sheet iron pipes and the supply is obtained from the Kioto-Fu Che canal.

California and the whole Pacific region show the progress already made in the transmission of electrical energy by means of water power. Transmission of electrical power with them is no longer an experiment but an established fact. Every waterfall is a mine of wealth, and is fast being converted into gold.

Away up on the top of the mountains nestled in among the clouds, 2,000 feet above Red Cliff, in the very heart of Eagle River canyon, is the town of Gilman, more than 11,000 feet above the sea level. Looking across from Gilman on the other side of the great canyon, there is a mountain stream called Fall River, rising in the mountain of the Holy Cross, and I can almost hear its roar as it crashes and tumbles down and over the rocks and enters the Eagle river at the bottom of the canyon. This water is brought by a pipe line into the mines and the fall is equal to 500 feet perpendicular, and its energy drives the dynamos, the electrical energy being conveyed to all parts of the richest mines of gold and silver in Colorado.

The Penobscot river, the largest in Maine, draining over 7,400 square miles, falls over 90 feet, giving several of the finest water powers in the world.

At a place called Veazie, which is situated four miles above Bangor, there is an electrical plant in the course of construction, which, when completed, will be one of the largest in the world.

Fifteen water wheels of 150 horse power each will be

[1] Abstract of a paper read before the Buffalo Electrical Society, April 6, 1891.

placed in this plant, so arranged as to run separatly or in groups. Six of the wheels are already in operation.

The plant will supply lights and power for the cities of Bangor and Brewer. The water power at Veazie is immense; the flow of the river at this point at low water is 146,000 cubic feet per minute, affording 2,500 horse-power with a nine foot head.

On the Salmon Falls river, the division line of the state of Maine and New Hampshire, light and power are not only furnished to Dover but to several distant towns. Power is also furnished to a street railway seven miles in length. The water-wheel has a capacity of 500 horse-power.

Extensive preparations are being made to utilize the waters of Lake Superior which fall at the Sault, about 30 feet, to the level of Lake Huron.

The water power at Sault Ste. Marie is estimated at having a velocity and volume of 122,000 feet per second, equivalent to 236,000 horse power. A tail race five miles long on the Canadian side and a canal five miles long on the American side are to be constructed. The canals will be each 1,000 feet wide, the widest in the world. Blast furnaces, ship yards, paper mills, pulp mills, flour mills and other industries will all be furnished.

There is no reason even in the present state of hydraulic and electrical engineering, why the tidal stream of the East river between New York and Brooklyn cannot now be made available for transforming it into electrical energy, for distribution to all parts of New York, Brooklyn and Jersey City.

Upon the beautiful Spokane river is Spokane Falls, now one of the prominent cities of the West.

In 1885 when the present city was a mere town of a few thousand inhabitants there was a little wooden shed erected in which there was placed an electrical plant, capab e of furnishing electrical energy for twelve arc lights and less than three hundred incandescents. One water-wheel furnished the power to run the dynamo and the whole affair had, up to a short time ago, a varied and checkered career.

Now consider the contrast. The power in Spokane Falls compared with the water-power so far developed in any country, is the peer of them all. As the development proceeds and its immense force is made fully available, its financial value will be stupendous. To replace the power by steam, would necessitate the outlay of $10,000 per day for fuel alone. An idea of its actual money value may be obtained, when it is stated that the cost of producing one horse-power per year by steam is $50, and the lowest total power available at Spokane Falls is 30,000, the amount of wealth annually added to that city on the basis of $50 a horse-power per year would be $1,500,000.

The power station now seen at the same place where the little wooden shed stood in 1885 is one of the greatest in the world.

The experiment of transmitting three hundred horse-power electrically from Lauffan on the Neckar to the Frankfort exhibition, a distance of one hundred miles, will be tried the coming summer.

The result of preliminary experiments already made, indicates that the proposed transmission will be a complete success.

I have seen an electric arc light produced in Buffalo, the energy for which was supplied at a point beyond Syracuse, N. Y., over a No. 8 galvanized iron wire, a distance of over a hundred and fifty miles.

The Brush Electric Light & Power company furnish light not only for Niagara Falls but for Suspension Bridge. The wires of the company also cross the river into Canada and light Niagara Falls, Ontario, making a circuit of several miles along the bank of the river on each side.

The idea of the tunnel at Niagara Falls originated with the late Thomas Evershed.

The tunnel or tail race is to extend from the surface of the water level below the Falls to a point on the Niagara river above the Falls. It is to be connected with the river by means of short surface canals, wheel pits and cross tunnels. The power expected to be produced by the capacity of the tunnel will be equal to the water-power of Lawrence Lowell, Holyoke, Turners Falls, Manchester, Bellows' Falls, Lewiston, Me., Oswego, Paterson, Augusta, Ga., Minneapolis, Rochester and Lockport combined.

The tunnel is to be of horse shoe shape, having a capacity equal to a circle of twenty-five feet in diameter, extending through the solid rock from the water level below the Falls to the upper river above the cataract, a distance of one mile. From this point the tunnel is to continue parallel with the shore of the river one and a half miles, at an average depth of 160 feet below ground and about 400 feet from the river, with which it is to be connected by means of surface conduits, through which the water from the river enters, and is drawn through the shafts and wheel pits into the great tunnel below. The plans adopted provide for the development 120,000 horse power.

The project for the electrical utilization of the Canadian Falls is well under way.

The Pelton Water Wheel company at San Francisco, Cal., has sent to the Niagara Falls commission at London, England, an estimate of the wheels and appurtenances for one block of twenty thousand horse-power. For an electric section, four wheels to develop 8,000 horse-power; for a compressed air section, one wheel of 4,000 horse power, and for the hydraulic or pumping section two wheels of 4,000 horse-power.

Speaking of electrical hardware, *Iron Age* says that the hardware merchant should familiarize himself with this branch of the business and consider the advisability of carrying an assortment of leading goods of this description in stock. "Although the assortment of electrical goods in the hardware line is already large," it says, "the limit has not been by any means reached in the applications which will be made of electricity in this field, and the progressive merchant in each town, who carries even a limited stock of electrical supplies, will be the one sought by the manufacturers to introduce new goods in this line as they are put upon the market."

CORRESPONDENCE.

New York Notes.

NEW YORK, April 4.—The report that the Rapid Transit commission had come to a decision on the important question that it has under consideration proves to be unfounded. President Steinway says that the commission has made no decision. "At present," he is reported as saying, "we are trying to ascertain whether electricity will not carry 20,000 passengers an hour and shall examine many prominent electricians upon the possibilities of this force. The commission has narrowed its attention to seven or eight plans and will announce a decision in about eight weeks." In the meantime people are clamoring for immediate relief and an additional track for the elevated railway at Battery Park would afford a means to that end. The bill permitting the extension of rapid transit facilities by leasing a strip of Battery Park for the elevated railway seems to have been hastily considered by the assembly committee on cities. The decision of the committee to report adversely is vigorously attacked by the many advocates of the bill who had been promised an opportunity to be heard in its behalf.

The raid on the poles and wires has continued during the week. At the meeting of the Board of Electrical Control last Tuesday the charge that Chief Engineer Kearney had favored certain electric companies was considered, but the withdrawal of the complaint made by William H. Kelly of the East River Electric Light company made rather a tame meeting. The order of last December, which required electric light companies to remove all wires from Eighth and Fifty-ninth streets, was revoked so as to give the companies more time. The United States and the Brush companies are taking down some of their poles, but the Bureau of Incumbrances is making haste to assist, and the consequence is that the lower part of the city is nearly freed Expert Wheeler was censured by the mayor because the list of housetop wires was not forthcoming, and thus the electrical farce continues.

The Board of Railroad Commissioners will give a hearing on April 8th to the application of the Coney Island and Brooklyn Railway company asking for permission for a change of motive power from animals to electricity, over and along Coney Island avenue in Flatbush and in Fifteenth street and Ninth avenue in Brooklyn.

The grand jury has found an indictment for misdemeanor against the twelve officers and directors of the New Haven railroad company, who are held responsible for the collision in the Fourth avenue tunnel. The following presentment was handed the judge: "The grand jury has been made satisfied that the present system of signaling in the Grand Central tunnel of the Harlem Railroad is inadequate. A part of this inadequacy is due to conditions of fog and smoke, which serve to obscure the signal lights. Some efficient system of audible signaling ought therefore to be added—some connection with the danger signal, which, in contact with the locomotive, should sound an alarm within the locomotive cab, as an unmistakable notification to the engineer that the danger signal is set against him. We further recommend that the State Railroad Commissioners be immediately empowered and directed by the legislature to recommend and require such further improvements and means to public safety throughout this entire tunnel system as can be skillfully devised."

The investigation of the State Railroad Commissioners into the disaster resulted in a confirmation of the opinion of Mr Depew, who claims that the lighting of the tunnel by electricity would tend to render signal lights less visible. The New York Central's President says: "I have received since the late accident about 300 plans for lighting and ventilating the tunnel and changing the signals. The writer in each case guarantees the absolute success of his suggestion. The difficulty, so far as we are concerned, is that 299 unite in declaring each of the other men's plans absurd. In other words, each inventor praises his own plan as against all the others, but unites with all the others as against any other fellow's plan."

A leading exponent of the genus crank has caused some amusement by writing to the *Sun* to say that, in his judgment, "Electric microbes killed Gen. Sherman, killed Gov. Robinson, killed Lawrence Barrett, killed Dr. Crosby, and are to day killing thousands in our cities and towns throughout the land."

A son of C. W. Johnson of Passaic City, N. J., started out on Thursday with his horse and truck. The horse stepped on a telephone wire and dropped to the ground instantly. The telephone wire had crossed the overhead wire of the Passaic & Clifton Electric railroad. The current passed through the iron part of the wagon, and caused the lad to fall to the ground also.

W. H. T.

Kansas City, Mo.

KANSAS CITY, Mo., April 4.—Judge Slover heard the affidavits and arguments in the injunction case of the Kansas City Electric Light company on Tuesday and Wednesday in his chambers. He took the case under advisement. In August, 1889, the American company, having the necessary permit and franchise, dug the holes for a line of poles along Santa Fe street from Tenth street to Union avenue. The Kansas City company put up a line of poles on the same part of Santa Fe street on the same side. One Sunday last January the American company hastily erected its poles. The next day the Kansas City company chopped down several of the newly erected poles. The board of public works then became interested in the matter, and decided that it would leave the street more roomy to have both sets of electric light wires on the same poles. It ordered the American to erect a new line of fifty-five-foot poles, placing on them sufficient cross bars below those occupied by the American for the Kansas City to put its wires on. The Kansas City company immediately appealed to the circuit court for an injunction restraining the American from obeying the order of the board. On the argument before the judge affidavits were read and oral statements made by electricians from New York, Philadelphia, St. Louis, Omaha and Kansas City, giving varying opinions as to the danger of stringing two sets of wires on one line of poles.

The directors of the Western Electric Storage Battery company held their first meeting this week for the purpose of organization. V. J. Love of Kansas City, Kansas, was elected president, Thos. F. Clohesey secretary, and A. A. Lovelace treasurer.

The electric light plant which will be placed in the basement of the new city hall, will cost about $15,000, and will supply about 300 incandescent lights in the building and the market house, and 125 arc lights for lighting the entire north end of the town and around the bluff to the Union depot. The new terrace park along the bluff will also be lighted from this plant as well as the Grand avenue depot property, the Martin depot and the Winner depot and yards. Gradually the plant will be enlarged and finally half of the city will be lighted by electricity generated in the city hall.

T. J. Enright of the Thayer-Enright Street Railway company appeared before the Kansas City, Kansas, city council this week for the purpose of getting an extension of time for completing the road from the Quindaro boulevard down Seventh street, over the viaduct and through Armourdale.

A. B. Richards has succeeded F. K. Holsinger as manager of the Postal Telegraph company's Kansas City office, and E. A. Quick, cashier, has succeeded Mrs. L. C. McKillop, resigned. B. F. Rommell succeeds Mr. Richards as chief operator. Edward Shales of Chicago, the company's inspector, who has been here for about two weeks arranging matters, will return to Chicago. Ex-Manager Holsinger, it is stated, will go east.

A bill has been introduced in the Kansas legislature providing that Kansas City, Kan., may acquire control of its own electric light plant, and may supply itself and its citizens with the means of lighting. The bill grants to the mayor and council of any city of the first-class power by ordinance or resolution, to construct, maintain and operate electrical or other works for the purpose of lighting the streets, and furnishing light to the inhabitants.

The decision in the case of J. W. Montgomery against the Western Union Telegraph company, which has been argued before the court of appeals, will determine the nature of a private dispatch.

The grand circuit of the Electric Fraternal Benefit association has been incorporated. The officers and incorporators are William S. Brener, president; E. D. Moore, secretary; A. O. T. Pennington, treasurer; P. C. Palmer, medical director; Wm. H. Woodring, Harry Mordau and J. S. Crergan.

P.

Milwaukee, Wis.

MILWAUKEE, April 4.—The West Side Railroad company, Milwaukee's pioneer electric line, has mortgaged its property to secure the payment of $1,000,000 of new bonds.

The common council has ordered to a third reading the ordinance requiring the Milwaukee Street Railway company, which is about to equip its lines for electric motive power, to use the center-pole system. H. C. Payne, who appeared before the railroad committee on behalf of the company, stated that his company was willing to adopt the proposed system and was anxious to have the matter decided as soon as possible, in order to allow it to go ahead with the work of construction. An ordinance making a similar requirement of the Milwaukee & Whitefish Bay Railway company has been introduced in the common

council. There is some opposition to the system, as people fear that poles in the center of the street will prove dangerous, especially in the case of runaways.

Judge Gilson of the Superior court has taken the petition of F. E. Hinkley of Chicago, for the appointment of a receiver for the Milwaukee Electric Railway company, under advisement. During the argument it was claimed on behalf of Pfister that the fact that Hinkley himself induced him to loan the company $125,000 and take bonds as security nullifies the claim that the bonds were illegally issued. Another allegation was that the sum of $115,000 paid into the company's treasury by Hinkley was not a loan, but a part payment on his stock. It was further averred that the road, instead of being insolvent, is paying $10,000 a month over and above its operating expenses.

In his annual report Superintendent Kleinsteuber of the Police Alarm Telegraph states that his department now has in operation 148 telephones, 132 patrol boxes, 6 private boxes, 339 batteries and 117½ miles of wire. During the year two signal and two alarm circuits were built, ten new patrol boxes located and eighty patrol boxes changed to avoid induction from high tension currents. The patrol service responded to 3,724 alarms.

The Milwaukee Electric Light & Power company has commenced business. It is supplying both arc and incandescent lights.

The Edison Electric Light company's fine new building on River street is about completed. The company, however, has experienced another delay in commencing operations. The plant will not be ready for operation for several weeks yet. The boilers are being placed in position, but the dynamos and other machinery have not arrived yet. C.

Pittsburg, Pa.

PITTSBURG, Pa., April 4.—A company has been organized in this city for the purpose of introducing the Shaver telephone with the intention of competing with the Bell Telephone company to some extent. The company will ask for a charter under the name of the West Penn Shaver Telephone company.

The Shaver telephone is also known as the molecular telephone. In appearance it resembles the Bell instrument very much, except the transmitter, which is considerably larger. It can only be used for short distances, two miles being about the limit of its carrying capacity A peculiarity of this machine is that it is not necessary to stand close to the telephone, if one wants to speak through it. A person sitting in the center of a room can hear as distinctly as if he had his ear against the.

The promoters say that their telephone will be most useful for mills and other large manufacturing establishments. The Shaver telephone is now used by the government at Willets Point. The instrument is not an electrical device. E. H. H.

Cincinnati, O.

CINCINNATI, O., April 4.—The Main Street Electric Railway company has mortgaged its line, with all machinery and appurtenances, for $150,000 to the Columbia Fireman's & Trust company of Louisville, Ky. The loan is for the purpose of extending the road and making needed improvements.

The Star Electric company, recently burned out, has rebuilt its shops on the old site, 218 West Second street, and is ready for business.

The South Covington & Cincinnati Electric railway, equipped with the Short double trolley system, has abandoned the sliding contact trolley, which it had been using since the road was started, and is now using the ordinary trolley wheels.

The Edison General Electric company, which has a capital of $1,000,000, has commenced work on its station, which is to be a handsome nine story structure entirely of brick and iron and located on the north side of Eighth street just east of Plum. The company expects to be in operation within four months.

The first electric welding apparatus introduced in this city has only recently been installed in the works of the Blymyer Ice Machine company on West Eighth street. It is of the alternating type, Thomson-Houston make, and is doing remarkably well. In making 11,562 welds but 33 were defective and required going over. All these joints were of piping and most of the 33 defective ones were caused by the inperfect defective longitudinal lap welding of the pipe itself. G.

The Mt. Adams & Eden Park Railroad company have just contracted for the iron poles to be used in equiping its road. The Thomson-Houston double trolley system will be used. The Walton Architectural Iron company of this city, and the Walworth Manufacturing company of Pittsburg were the fortunate bidders.

The National Galvanic Battery company has discontinued operations.

The Queen City Electric company, which manufactures electric motors and dynamos and also operates one of the most successful incandescent lighting and power stations in this city, had its origin in the Silvey Electric Light & Motor company, which was organized in 1886. In 1888 the Silvey company was reorganized under the name of the Queen City Electric company and with increased capital commenced operating an electric lighting and power station in connection with their manufacturing business. They have made several additions and now they have one of the best equipped plants in this city. Their shops and offices are on the first floor of the Murdock building 50–58 Longworth street, this city, and their station occupies the entire basement space under their shops, all being in charge of L. W. Davis, superintendent. They employ 80 men in the several departments. At present their station is equipped with four Lane & Bodley tubular boilers of a combined capacity of 800-horse power, one 220 horse power Lane & Bodley Corliss engine, one 125-horse power and two 200-horse power Ball automatic cut-off high speed engines, Laidlaw & Dunn pumps and Hoppes heater. The dynamos are of their own make and consist of twelve 5000 light 110 volt generators for lighting circuits and one 220-volt and one 440 volt generator furnishing a maximum of 300-horse power for their motor circuits. Their wires are all overhead at present but an ordinance granting them the use of the streets and alleyways of the city for the laying of their underground system is now under consideration by the Board of Public Improvements. Their system is somewhat similar to that of the Edison company, except that they do not use the three wire system, using two 10 inch cast iron pipe lines, one for positive and one for negative wire, with manholes at the intersecting streets and alleyways. They have secured the site for another station on Patterson street near the government building and are at present contracting for the necessary machinery and by the first of May expect to have it in operation. They use the Sawyer-Mann and Packard lamps in the station work.

The Central Thomson Houston company has moved its offices and supply house and taken the entire building formerly occupied by the Novelty Electro Supply company.

The Western Electric company of Chicago has just in stalled a lighting plant in the establishment of the Frey Printing company of this city, consisting of one 40-light arc and one 200-light incandescent machine with all necessary apparatus.

Campbell Scott, late of Louisville, Ky., is now in charge of the United Edison Manufacturing company's business in this city with offices and supply rooms in the Smith building, 220 Walnut street. G.

Indianapolis, Ind.

INDIANAPOLIS, April 4.—Electrician Hickley of the Citizens' Street Railway company has made a valuable improvement in the motors of the storage battery cars on Irvington line. The addition of this contrivance increases the speed. The cars are running nicely now, making regular trips and giving satisfaction.

The city light question is still unsettled. The representatives of the Brush company have been before the Board of Public Works this week endeavoring to agree upon prices for present lighting. Since the contract expired some weeks ago the Brush company has, through an arrangement with the old council committee on lighting, continued to furnish light but with no agreement as to price. So far no agreement has been reached; the company seems disposed to be fair. The future lighting contract will cut something of a figure in settling the present price. Frank Winder of the Western Electric company has also been before the board urging them for an early decision on his proposition to light the city; also to furnish a plant to the city to do its own lighting, for $300,000 to be paid in semi-annual installments of $25,000 each. The board is not yet ready to make a contract.

Since the legislature passed the suburban street railroad bill, new street railroad lines are appearing everywhere.

A petition was presented at meeting of trustees of West Indianapolis Monday night asking for right of way through that suburb for the Plainfield, Fairview & Indianapolis Electric suburban line. Hearing was postponed, as the company was not incorporated.

The Greenwood & Indianapolis suburban line have decided on an overhead system of electric motors but so far have not secured right-of-way into city.

The Broad Ripple electric line has decided on an overhead system and has asked the Board of Public Works for a route through streets into the central part of the city. The company has had several conferences with the Citizens' company trying to agree on a basis for rental, etc, for use of tracks inside the city limits, but without success.

If half the lines are built that are talked of, Indianapolis will be well supplied with rapid transit to suburbs. M.

Denver, Colo.

DENVER, Colo., April 4.—Street railway construction for the year 1891 is already well under way in this city, and lively times are ahead between the rival companies. The Denver and Suburban company, which has done most of its work on paper for the past six months or more, has begun laying track on the north and west sides, and on Wednesday night stole a march on rival companies by laying a crossing over the Denver Tramway company's line at Fifteenth and Champo streets. The Tramway company promptly appealed to the courts and secured an injunction against further proceedings of that character, but the crossing was laid and the Suburban had secured what it had to have or retire from business, an entrance into the business portion of the city. The Suburban has one hundred men and seventy-five teams at work and expects to have cars running within ninety days. The rolling stock is being turned out at Pullman and the rails are expected within a few days. The electric plant will be built on the west side of the Platte on land donated for that purpose by the owners of Fairview additions.

The University Park electric line recently purchased by the Tramway company will be extended a mile and a half farther south, making its entire length about five miles. The new route will pass the University building and the Chamberlain observatory.

The Highlands Electric Light company, of which F. J. Arbuckle is the head, has made that suburb an offer intended to settle the trouble existing there over electric lights. The new company agrees to have lights ready within ninety days and furnish arc lights at $11 a month. It further proposes to put in an electric fire alarm system free of cost to the town and erect an $80,000 plant. No action has as yet been taken by the town trustees but they are inclined to look upon the proposition with favor and may annul the franchise of the present company at the next meeting. No money has been paid the present company since November 1st.

The Denver, Lakewood & Golden Electric Railway company has graded the entire length of its line from the Platte river to Golden except about 700 feet at each end of the line. It was reported that negotiations were on foot to transfer the franchise of the road to the Burlington & Missouri railroad, but officers of the company deny it and say they propose to go ahead and make it the best equipped electric railway in the country. C. W. C.

Detroit, Mich.

DETROIT, April 4.—The Detroit Suburban Street Railway company has asked for a franchise to run electric cars from the western city limits to the city hall. The company was organized some time ago with a capital of $500 000, to operate an electric railroad between Detroit and Wyandotte, a distance of 12 miles. It is proposed to have the line in operation very soon if the common council will grant the franchise.

The Edison Lighting company of Detroit is receiving bids for additional engines of 400 horse power, for use in the main plant, and is increasing the capacity at the sub-station by the addition of dynamos. The company is also introducing an arc light.

The Hudnut Electric Light company, at Big Rapids, Mich., which is operated by water power, has at an expense of $12,000, enlarged the plant so that both arc and incandescent lamps for commercial purposes are supplied in large numbers.

PERSONAL.

Geo. Cutter of Chicago returned last week from an extended business trip.

R. C. Wiggin, general manager of the Thomson-Houston Motor company, was in Chicago last week.

J. N. Morris, secretary of the Bargion Compound Rail company of San Francisco, was in Chicago last week.

C. W. McDaniel, superintendent of the Missouri & Kansas Telephone company, Kansas City, Mo., was in Chicago last week.

W. R. Mason, manager of the Electric Merchandise company of Chicago, has been elected president of the Burton Electric company of Richmond, Va.

J. H. Rhotehamel, president of the Columbia Incandescent Lamp company of St. Louis, Mo., was in the city last week. Mr. Rhotehamel will shortly make an extended southern trip in the interest of his company.

NEW INCORPORATIONS.

La Roche Electric works, Philadelphia, Pa.; capital stock $100 000; manufacture of electric appliances.

Queen City Electric Street Railway company, Marion, Ind.; capital stock, $150,000; to operate a street railway.

Keesville Electric Light & Power company, Keesville, N. Y.; capital stock $40,000; to supply electric light and power.

Pecatonica Electric Light & Power company, Pecatonica, Ill., capital stock $10,000; to supply electric light and power.

Gonyard Electric company, Denver, Colo.; capital stock, $100,000; to operate an electro-magnetic process for treating ores, etc.

Fulton Electric Light and Power company, Fulton N. Y.; capital stock $80,000; to manufacture and supply electricity, for commercial uses.

Waverly Electric Light & Power company, Waverly, Ill.; capital stock, $37,500; to manufacture and supply electricity for light, heat and power.

Waters Electric company, Portland, Maine; capital stock $250 000; manufacture and deal in all kinds of electrical machines, machinery and dynamos.

The Wilkes Electric Supply company, Toledo, O.; capital stock $10,000; manufacturing, buying, selling and general dealing in electrical supplies, materials, merchandise, cars etc.

The Western Water & Electric Light company, McPherson, Kan.; capital stock $25,000; erect and operate waterworks and electric light works, and furnish steam and electric power.

The Clinton Gas & Electric company, Clinton, Mo.; capital stock $80,000; for the manufacture and generating of gas and electricity for fuel, power, illuminating, etc., and to sell the same, also coke, tar, naphtha, etc

Dawn Electric company, Chicago; capital stock $20,000; electrical construction business and control, operate and sell electric light and power apparatus; incorporators, Henry P. Williams, J. A. McEntee and J M. Glenn.

The Menominee Range Electric Power company. New York City; capital stock $1,000; manufacturing, owning, operating, using and licensing others to manufacture, etc., machines for furnishing light, heat and power by electricity.

The Newport Electric Street Railway company. Cincinnati, O.; capital stock $100,000; constructing, maintaining and operating by electric power or any other system of motive power, other than steam, a street railway in Cincinnati.

The Neihart Electric Light & Power company, Neihart, Mont.; capital stock $20,000; establish an electric plant at Neihart, Meagher county, Mont., and furnish and generate electric light and electric power to citizens of Neihart and surrounding country.

Edison General Electric company, New York City, N. Y., and Butte, Mont.; capital stock $12,000,000; to manufacture, buy, sell, lease and use machinery, articles, apparatus and devices of every kind appertaining to the use or application of electricity for the purpose of light, heat, power, telegraphy, telephone and such other uses and purposes as the same may be employed in or applied to and generally to manufacture, buy, sell, lease and use machines, engines, mechanical devices and articles of every other character, and to carry on a general manufacturing business,

The Chicago Railway company, at Chicago, to construct a surface or elevated or partly surface and partly elevated railway from a point in Blue Island, Cook county, to a point in the business district of the central part of Chicago, at or near Lake street, with branches extending through the North, South and West divisions of said city and through the county of Cook; capital stock $50,000,000; incorporators and first board of directors, James T. Young, Martin M. Henneberry, William W. Yeates, Thomas B. D Bradley, John McNichols, Marcus Kavanagh, James V. O'Donnell, William D. Munhall and Michael Mitchell, all of the city of Chicago.

ELECTRIC LIGHTING.

A municipal plant for Philadelphia is talked of.

The authorities of Buffalo, N. Y., are considering the municipal ownership of an electric light plant.

The city board of trade of Roseburg, Ore., has appointed a committee to organize an electric light company.

It is now stated that the Citizens' and Municipal Electric Light companies of Brooklyn, will not be consolidated as reported

The Capital Electric Light, Motor and Gas company of Boise City, Idaho, will increase its capital stock from $20,000 to $50,000.

The city council of Wheeling, W. Va., has decided to install an electric light plant having a capacity of 400, 2,000 candle power arc lamps.

The old Breton town of St. Brieux is to have the first electric lighting station in France on the Thomson-Houston alternating current system. The generating plant is situated at a spot 15 miles from St. Brieux. The installation was put in operation on Easter Sunday

The real estate and lighting plant of the Hamilton, Ont. Electric Light company is to be sold at auction on April 15th, to satisfy mortgages held by the Canada Permanent Loan & Savings company of Toronto, to the amount of $148 000. The company supplies 400 arc and between 2,000 and 2,500 incandescent lights.

Four or five thousand incandescent lights will be used in the Palace hotel of San Francisco, when the entire plant in contemplation is installed.

The Land, Reservoir Power company has been formed in Los Angeles, Cal., to furnish electric lights to the people of Covina, Puente, and other points.

The Minneapolis *Lumberman* says that 'The electric light has become so important an adjunct of every sawmill that the engineer finds that it is necessary to have a knowledge of electricity as well as of his engine and of steam as a power"

ELECTRIC RAILWAYS.

St. Louis has eight electric roads.

An electric road is to be built from the City of Mexico to Chapultepec.

Twenty miles of electric railways are now in operation in Galveston, Tex.

The new cars on the People's line in Springfield, Ill., are provided with electric heaters.

An electric road is to be built to connect the villages of Niagara Falls and Suspension Bridge, N. Y.

The Tacoma Railway & Motor company has negotiated a loan of $70,000 and will resume work on its principal lines.

The work of equipping the Glens Falls, N. Y., street railway for electrical operation will begin as soon as the frost is out of the ground.

It is proposed to connect the city of Trinidad with the leading gold and silver mining sections of Colorado by an electric railway several hundred miles long.

The Lynn & Boston Railroad company has received permission to issue additional stock to the amount of $500,000 for the purpose of further equipping the road for electric motive power.

The Lindell Electric Railway company of St. Louis operates 80 motor cars and 120 trailers. Its power station is the largest in St. Louis. Edison generators of 1,400 horse power capacity are used.

It is said that a Boston company has acquired possession of the Fulton county street railway of Atlanta, Ga., and that it is trying to secure all the other lines of that city. In that event electricity will be substituted for animal power.

The Edison General Electric company of New York has recently made a contract for the construction of another electric road in Savannah, Ga., three miles in length, to run through St. Julian and Price streets. This will give Savannah fifteen miles of electric railway in operation.

A company has been organized to build an electric railway to connect Portland, Ore, with Oregon City, fifteen miles distant. The greater part of the rights of way has been secured, and the line will be completed to Oswego, where the works of the Oregon Iron and Steel company are located, by the end of the year, and to Oregon City by June 1, 1891. This will be the longest electric road in Oregon.

Owing to poor management the Concord, N. H., electric road was subject to much unfavorable comment early last winter, on account of delay caused by snow. Since G. W. Pierce, the new superintendent took charge in January, there has not been the slightest delay. So successful has been his management that the directors have decided to double the service by the addition of new generators, cars, etc, and to change from narrow to standard gauge. An extension of several miles is contemplated.

The common council of Grand Rapids, Mich., has granted the petition of the Valley City Street & Cable Railway company for a franchise for an electric line. Ten thirty horse power motor equipments have already been ordered from the Detroit Electrical Works. These are to be in operation by May 15th. It is expected that about thirty more cars will be equipped during the coming summer. Eventually the large Hamilton Corliss engines, formerly used for the abandoned cable system, will be used to furnish power for the generators.

ELECTRIC MOTOR.

The Detroit Electrical Works last week shipped and installed a 15 horse-power motor at Saginaw, Mich., for the Barrett elevator company of Cleveland, to operate a passenger and freight elevator in a new hotel at Saginaw. The motor arrived in the morning, was installed the same day, and has been operating nicely ever since. It is supplied with current from the street railway circuit of Saginaw.

In the recent competition instituted by the Cataract Construction company for the utilization of the power of Niagara Falls, says the *Engineering and Mining Journal*, there were fifteen different schemes presented, of which seven proposed electrical transmission of power, two hydraulic, and six pneumatic. Of the electrical schemes two advocated alternate current transmission at 5,000 and 10 000 volts, and the remaining five continuous current transmission at potentials varying from 1,600 to 4 500 volts. The fact that the number of electrical schemes proposed was less than the sum of the pneumatic and hydraulic plans, said Gisbert Kapp, in a recent lecture before the Society of Arts, London, showed that electrical engineers were scarcely prepared to deal with a problem of this magnitude. At present the limit of distance for the electric transmission of power at a reasonable cost is about four or five miles. Beyond the latter distance the economical voltage for 500-horse power is beyond the capacity of one machine. Practically, the extreme limit for direct currents is between 2,000 and 3 000 volts.

ELECTRIC MINING.

The Detroit Electrical Works announces that it is ready to engage in manufacturing electrical mining machinery.

A method of blasting by electricity has been tried in Sweden, in which an arc is produced between two carbon rods placed parallel. When the arc is moved close to the spot to be blasted, an intense local heat is created, resulting in expansion that splits the rock

The Eastern Electric Cable company, Boston. Mass, announces that it has had the Clark wire in use in mines for several years. In one case the wire was cleated to the woodwork of the shaft. It is continually covered with dripping water and mud and in winter is covered with ice. This wire is carrying 2,000 volts, and has done so for over two years on six circuits, each 1000 feet long. A number of other mines, gold, silver and coal, have more recently been wired.

The commercial application of electricity to mining machinery is of recent date but the idea is one capable of great expansion. According to Wells, Fargo & Co.'s report of precious metals produced last year, the states and territories west of the Missouri River, including British Columbia, show: Gold $32,156,916; silver, $62,930,831; copper, $20,569,092; lead, $11,509 571. California produced in gold, $9,896,851, silver, $186,263; Nevada, gold, $2,693 884, silver, $6,546,652; Oregon, gold, $965,000, silver, $71,000; Washington, gold, $194,000, silver, $85,000; Idaho, gold, $1,595,333, silver, $10,229,167, Montana, gold, $2,764,116, silver, $12,050,339; Colorado, gold, $4 210,961, silver, $13 064,486; Utah, gold, $88,798, silver, $12,170,377; New Mexico, gold, $376,034, silver, $1,282,951; Arizona, gold, $1,150,486, silver, $6 446 863; Dakota, gold, $3 045,560; Texas, silver, $246,423; British Columbia, gold, $361,555; Mexico, gold, $12,989,000, silver, $415,645,000.

ELECTRIC WELDING.

Iron pipe is now welded by electricity at the Columbus, Ga., iron works. Columbus is the first city in the South in which this new system has been employed. The managers of the iron works expect to effect a considerable saving over the old method, each weld taking about seven seconds. From the time of finishing one weld until the completion of the next takes about one minute. This includes clamping the two pipes, adjusting the position of the machine, welding and taking out the pipes.

TELEGRAPH.

Jay Gould's holding of Western Union stock is placed at 230,000 shares.

Cyrus W. Field is confident that San Francisco will have cable communication with Japan in a few years.

The Indiana Telegraph company has been organized at Indianapolis, with a capital of $100,000. It will have the exclusive use of the writing telegraph system in the state of Indiana. It is proposed to establish an exchange in Indianapolis and to form local companies in other parts of the state, much after the idea of telephonic service.

At a meeting of the Asiatic society of Bengal, at Calcutta, a piece of cable was exhibited, showing that the India rubber covering had been pierced by a blade of grass. The piercing was so complete, and the contact with the copper core so perfect, that the efficiency of the cable was destroyed. The species of the grass, owing to its dried-up condition, could not be determined.

The last quarterly report of the Western Union Telegraph company shows a surplus of $11,321,137. President Norvin Green says that, "The gross revenues show a handsome increase over the corresponding quarter of the previous year; but the increased expenditures incident to the damage to our main building by fire and especially for maintenance on account of the unusually stormy season, have exceeded the increase in revenues. The net earnings are, therefore, somewhat below the estimate."

The people of Vancouver are awaiting the arrival of the British man-of-war Egeria, which has been engaged for the last two years in examining the bed of the Pacific Ocean, with the object of discovering the best route for a cable from Australia to Canada. Reports of her cruise have been received from the time she left New Zealand till she reached various groups of the islands of Polynesia, and they give assurance that she had been so far successful in the work in which she is engaged. From the Sandwich Islands northward to Vancouver no serious difficulties are anticipated. The length of the cable from Australia to British Columbia will be about 9,000 miles; but as there are a number of stations in the Pacific, the longest stretch will be about 2,700 miles, the others ranging from 1,200 miles upward. The new cable will be a powerful agency in bringing together the widely separated countries of the British empire. Along with the new line of British steamships from Hong Kong to Vancouver, it will also do much to promote the advancement of British commerce around the world.

TELEPHONE.

The San Francisco supervisors have granted the Pacific Telephone and Telegraph company the permission to add another story to its headquarters.

The London *Electrical Review* pronounces the new telephone line between London and Paris "an unqualified success." The total distance from London to Paris is 297 miles by the route the wires follow. Each line for the telephonic service consists of 83 miles of copper wire weighing 400 lbs. per mile between London and St. Margaret's Bay, near Dover, the landing place of the cable on the English side From this point to Sangatte, near Ca-

lais, the French landing place, a special form of cable has been laid, consisting of four conductors, each composed of a strand of seven copper wires, each stranded conductor weighing 300 lbs. per knot. The dielectric is gutta-percha, weighing 300 lbs. per knot, and the length of each conductor is approximately 21 knots.

At the annual meeting of the American Bell Telephone company Thomas B. Bailey was elected director in place of Stanton Blake, deceased. The annual report shows gross earnings for 1890 of $4,375,290, as against $4,044 704 in 1889; net earnings, $2,869,418, against $2,661,888 in 1889; surplus for the year, nothing, as against a surplus of $122,975 the previous year; total surplus, $2,151,011. There was paid in regular dividends $1,463,913, against $1,238,913 in 1890; in extra dividends $750,000 against $600,000. There is reserved $55,505 for depreciation of instruments, and $600,000 for general depreciation. The "long distance" system is earning a moderate rate on the investment above expenses. Its net earnings last year amounted to $120,600, which was invested in extension of the plant. The summary of the output of the telephones shows that the number of instruments Dec. 20, 1890, was 483,790, an increase of 38,929 over the previous year; the total number of stations is 202,931, an increase of 17,928. The estimated number of exchange connections daily in the United States is 1,438 294, or a total per year of over 450,000,000 The miles of wire on Jan. 1 last were 240,400, an increase of 47,000; of this 27,500 is a gain in mileage underground.

MISCELLANEOUS.

A short time ago some cool headed thief had the audacity to climb to the top of the chimney stack of the Narragansett electric light station, at Providence, R. I., 250 feet from the ground, and steal the platinum tips from the lightning rod points.

An international electrical exhibition will be held at Toulouse, France, this year. The exhibition will be open for a period of four months, from May 15th to September 15th, and will comprise the following sections: Electricity and electric lighting, electricity as applied to engineering, industrial and commercial chemistry, hygiene.

The account of the experiments of Professor Tolomei, an Italian scientist, on the relation of electricity to the souring of milk has drawn from Professor Treadwell of Wesleyan University a description of experiments made in the laboratory of that institution. In relation to the preservative effect of the electric current Professor Treadwell says: ' Professor Tolemei finds, also, that a slight electric current, if less than three amperes, will have a preservative effect on milk, the current being passed directly through the liquid. A current greater than three amperes will decompose the milk. In our experiments, a current of less than one-fortieth of an ampere was sufficient to produce decomposition, with a certain amount of coagulation at each electrode. A stronger current would produce complete coagulation with the somewhat curious result that the coagulum was strongly acid at the positive pole, and more feebly alkaline at the negative pole."

TRADE NEWS.

J. M. Lennon has opened an office at 22 Loan and Trust Building, Minneapolis, where he will hereafter conduct a general electrical business, and act as electrical expert.

Milliken Bros. closed a contract last week with the St. Louis & Suburban Street Railway company for poles for the company's electric line. The company intends to substitute electricity on all its lines.

The River & Rail Electric company of Denver, Colo., has sold to the Midland Electric company the supply branch of its business, excepting the storage battery cars, storage batteries and motors manufactured under the patents of the River & Rail Electrity Light company of West Virginia.

The Triumph Compound Engine company reports that it has just booked the second order of the Butte & Boston Mining company through Fraser & Chalmers, for an engine for electric lighting purposes, the mining company expressing itself well pleased with the first engine furnished.

Much valuable information in relation to electric elevators and electrically propelled fans is given in the new catalogue of the Detroit Motor company. There is also a weir table for determining the horse power of streams, and tables showing the pressure needed for various sizes of single and double cylinder pumps.

A descriptive catalogue just issued by Alexander, Barney & Chapin, New York, will certainly prove a very useful book to men engaged in electrical business. Nearly 2,000 articles used in the development of electricity are enumerated in the volume, most of them illustrated by very excellent cuts. Men not well versed in electrical matters will find many appliances minutely described, regarding their electrical value as well as their application. Such books are a help to everybody. It is of peculiarly striking and pleasing outward appearance. On the bottom of the front cover appears a switch by which a flap on the cover is opened or closed, and from which issues a flexible cord surrounding the catalogue.

BUSINESS.

The firm of S. H. Parvin's Sons, newspaper advertising agents of Cincinnati, has just celebrated its fortieth anniversary. This reliable house was the pioneer in its line and has well deserved the success it has achieved.

George Cutter has just returned from a trip to the East where he arranged to carry an assorted stock of Schaefer incandescent lamps at his Chicago quarters. He will soon have a stock of magnet wire, and continues to handle Simplex wire. The Pettingell-Andrews company of Boston will hereafter have a full stock of its K. W. cut-outs and rosettes at Chicago. George Cutter will handle them.

The merits of the Eddy automatic electric motors are attractively set forth in a new and beautifully printed catalogue.

Clower, Harris & Co., dealers in electrical supplies at Dallas, Texas, claim to have the most complete establishment west of the Mississippi.

Projectors of overhead electric railways will be interested in perusing the handsomely illustrated pamphlet, issued by Milliken Bros., giving "Information for Electrical Engineers and Builders of Electric Street Railways and Electric Lighting Plants." It contains much valuable information about the poles and brackets manufactured by this house. The firm's Chicago office is at 59 Dearborn street.

ELECTRICAL PATENTS.

Issued March 31, 1891.

449,106. Telephone Circuit and Apparatus. John J. Carty, New York, N. Y.
The last claim is:
"15. In a telephone station, a combined telephone apparatus comprising, a call-bell magnet of relatively high resistance in a branch circuit uniting the terminals of said apparatus, an electrical generator for sending outgoing calls in a normally discontinuous independent branch circuit extending between the same apparatus terminals in multiple arc with its associated bell-magnet and adapted to be closed when the said generator is operated, and a telephone normally disconnected, but adapted to be connected when in operation between the terminals of the apparatus."

449,108. Electric Cash Indicator and Recorder. William F. Z. Desant, New York, N. Y.

449,125. Elastic Metallic Pole for Electric Wires. Charles A. Lieb, New York, N. Y.

449,153. Hanger for Electric Lamps. Horatio A. Foster, New York, N. Y.

449 168. Art of Covering Electric Wires. Thomas W. Norman, Boston, Mass.

449,174. Telegraph-Transmitter. Harry G. Robbins, Minneapolis, Minn.
The first claim is:
"The combination, in a telegraph-transmitter, of a plunger with a spindle adapted to move therein and through the medium of which said plunger is adapted to be moved, a contact-stud provided in said plunger and adapted to make contact with said spindle when said spindle is moved positively, a contact brush or point extending from said plate, and a secondary plate or series of plates arranged in the path of said brush and adapted to make contact therewith when said plunger is operated, whereby said spindle forming one terminal of an electric circuit and said secondary plates the other terminal, said circuit is closed upon the operation of said plunger."

449,180. Telephone Sound-Transmitter. Adam E. Schatz, New York, N. Y.

449,186. Thermo-Electric Battery. John N. Webb, Birmingham, Ala.

449,188. Electric Switch. William White, London, England.

449,196. Electric Railway Conduit. Francis O. Blackwell, New York, N. Y.

449,197. Electric Motor Truck. Francis O. Blackwell, New York, N. Y.

449,206. Electro Magnetic Device. Moses G. Crane, Newton, Mass.

449,209. Electric Fuse. George F. Curtiss, Lynn, Mass.

449,226. Guard for Electric Railway Trolleys. Andrew W. Mitchell, Boston, Mass.
The object of this invention is to prevent the accidental detachment of the trolley-wheel of an electric railway car from the electric wire, and the invention consists of a trolley wheel for an electric railway car provided with means to prevent the accidental detachment of the trolley wheel from the electric wire, which is arranged to be easily attached and detached therefrom when desired.

449,227. Electrical Railway System. Samuel F. B. Morse, Brooklyn, N. Y.
This invention is an improvement in electrical railway systems in the means of conducting and delivering the electric currents generated at the central or power station to the cars carrying the electro magnetic motors, and running on the track or tracks of the system.

449,236. Electric Arc Lamp. John H. R. Ward, New York, N. Y.

449,237. Electric Arc Lamp. John H. R. Ward, New York, N. Y.
This invention relates to the details of mechanical construction of that type of electric arc lamp which is adapted for especial use with incandescent electric lighting circuits or those circuits in which the current is of comparatively low electromotive force.

449,238 Electric Arc Lamp. John H. R. Ward, New York, N. Y.

449,245. Dynamo Regulator. Burnett H. Fisher, New York, N. Y.
The object of the invention is to provide a dynamo in which the brushes are automatically adjusted to the proper position for least sparking and waste of current, and whereby the motion for adjusting the brushes is obtained from that of one of the field magnets.

449,249. Electric Cash Register System. Robert E. Nelson, Jr., Columbia, Va.

449,254. Telephone. William Humans, Cambridge, Mass.
The invention consists essentially, of a compound permanent magnet consisting of at least two permanent magnets, each forming a portion of an annular or rectangular case, a diaphragm, and one or more pole pieces, the free end of each pole piece being within the case and under the diaphragm.

449 258. Method of and Apparatus for Electric Soldering. Almon Robinson, Lewiston, Me.

449 266. Hanger Board for Electric Fixtures. George R Lean, Boston, Mass.

449,272. Submarine Blasting. Theodor Puskas, Buda-Pesth, Austria-Hungary.

449,282. Electric Switch. Horace T. Clark, Bridgeport, Conn

449,288. Regulating Apparatus for Electric Currents. Wilhelm Lahmeyer, Aix-la-Chapelle, Germany.

449,289. Fuse for Electric Circuits. Francis W. Maxstadt, Chicago, Ill.

449,299. Galvanic Battery. Henry P. Stoecker, New York, N. Y.

449,301. Cut-out. Charles S. Van Nuis, New Brunswick, N. J.

449,302 Electric Contact Protector. Richard Varley, Jr, Englewood, N. J.

449,307. Binding Post for Electric Wires. Henry P. Ball, Brooklyn, N. Y.

449 315. Electric Belt. Duane P. Andrus, St. Louis, Mo.

449,348 Electric Contact. Otis J. Depp, St. Louis, Mo.

449 356. Manufacturing Chains by Electric Welding Process. Elihu Thomson, Lynn, Mass.

449,357. Burr Preventer for Electric Welding Machines. Elihu Thomson, Swampscott, Mass.

449,358. Electro Magnet. Ferdinand A. Wessel, Brooklyn. N. Y.
The invention is applicable to electro magnets generally, whether stationary or movable, and whether provided with a magnetic or a non-magnetic core or carrier, but is especially applicable to stationary magnets having an iron core—such, for instance, as the field magnets of dynamo electric generators or motors.

449,362. Electric Switch Box. James H. Dean, Minneapolis, Minn.

449,375. Pole for Electric Wires. Julius Meyer, New York, N. Y., and Carl Binder, Chicago, Ill.

449,400. Insulated Electric Conductor. James D. Bishop, Brooklyn, N. Y.
Claim one follows:
"An electric conductor comprising a conducting core wound with a paper ribbon, the spiral edges of which are separated by a spiral air space and inclosed within a protective sheath."

449,403. Electric Lamp Reflector. Frank Cooley, Cincinnati, Ohio.

449,404. Electric Heating Apparatus. Mark W. Dewey, Syracuse, N. Y.

449,407. Shade for Electric Lights. James W. Easton, New York, N. Y.

449,411. Electric Alarm for Shaft-Bearings. George Hannah, Brooklyn, N. Y.

449,468. Automatic Electric Weighing Scale. John V. Davis, Ashland, Ky.

449,474. Electric Lighting System. George Gibbs, Milwaukee, Wis.

449,490. Guard for Electric Railway Trolleys. Andrew W. Mitchell, Boston, Mass.

449,569. Automatic Trolley Catcher for Electric Railways. Byron J. Parsons, Omaha, Neb.

449,574. Repeater. Frederick W. Cole, Newton, Mass.
Of the twenty claims the eighteenth is given:
"The combination of the main relay magnet and armature with a governing magnet and armature therefor, a pendant connected with said governing magnet armature engaged by the main relay armature and a switch engaged by said pendant when the governing magnet armature is moved while the main relay armature is in abnormal position."

449,575. Non Interference Signal-Box. Frederick W. Cole, Newton, Mass.

449,576. Non-Interference Signal Box. Frederick W. Cole, Newton, Mass.
The invention comprehends the employment of signaling mechanism of any suitable construction, a non-interference magnet, its armature, a locking arm or lever for the signaling mechanism, and a fulcrum lever by which it may be moved. The fulcrum of the fulcrum lever is controlled by the armature of the non-interference magnet, and constitutes the box controller.

449,604. Incandescent Electric Lamp Socket. Franklin A. Weller, Boston, Mass.

449 610. Magnetic Separator. Richard R. Moffatt, New York, N. Y.

449,611. System of Operating Electric Elevators. William Baxter, Jr., Baltimore County, Md.
The invention involves the use of an operative electric circuit, the current in which is controlled by switches located either upon the car or at stations along the path of the car, and operated to effect the hoisting mechanism in the desired manner to raise or lower the car, or to stop the same at pleasure.

449 639. Electric Railway Signal. Stonewall Tompkins, Knoxville, Tenn.

449,651. Electro Therapeutic Syringe. Edwin Bartsch, San Francisco, Cal.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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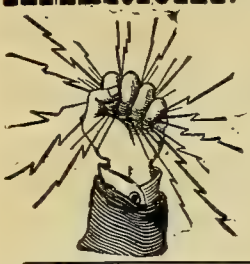

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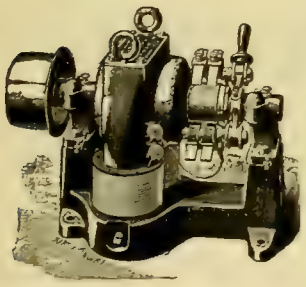

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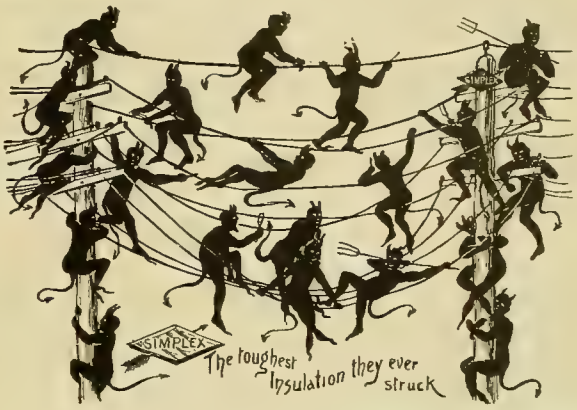

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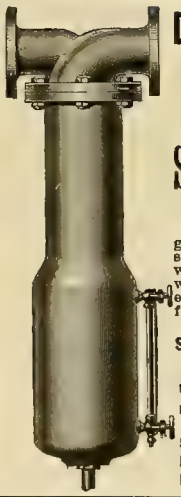

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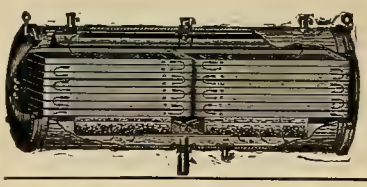

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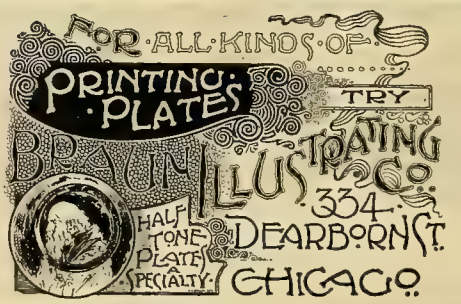

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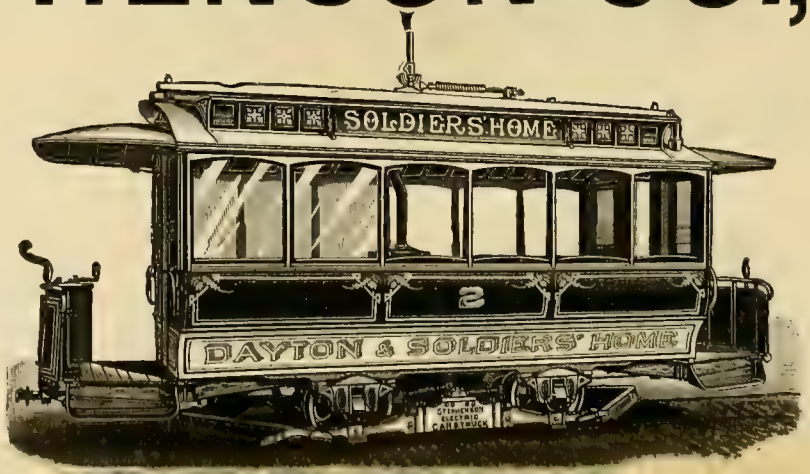

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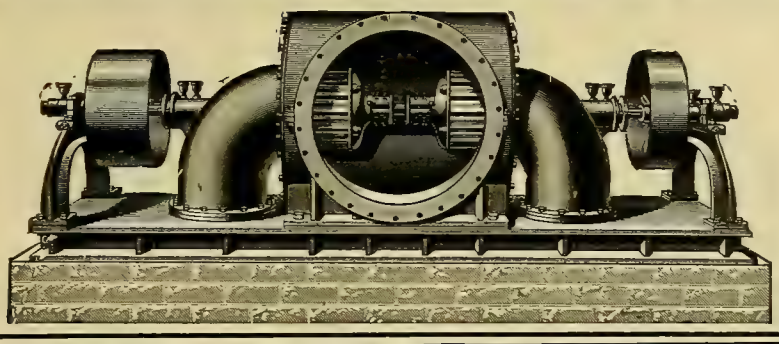

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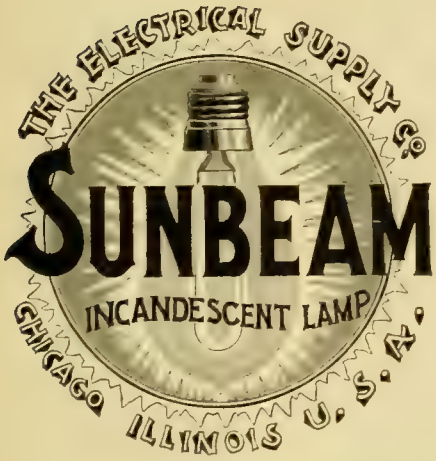

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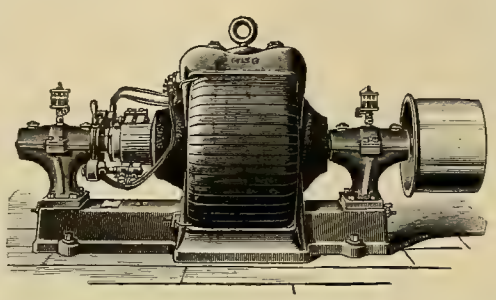

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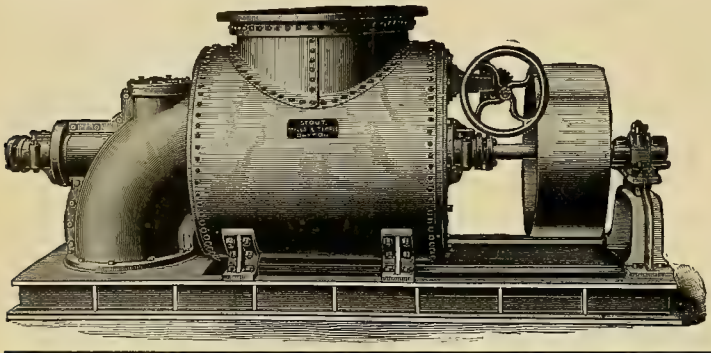

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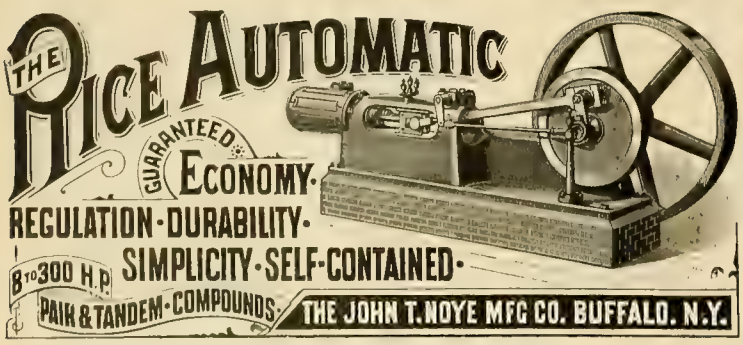

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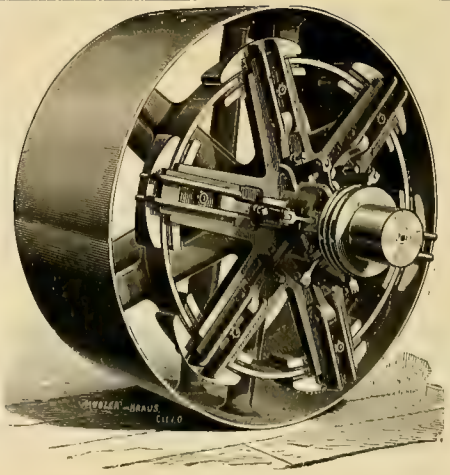

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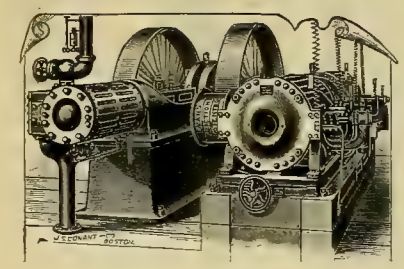

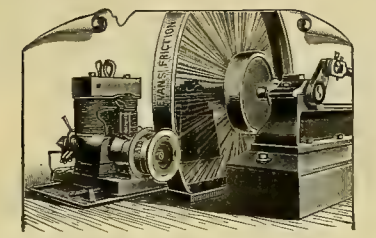

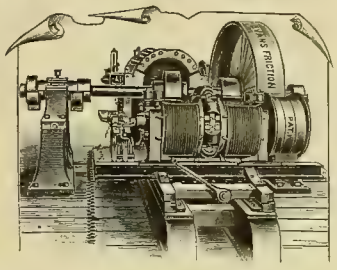

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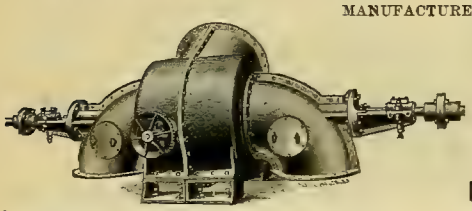

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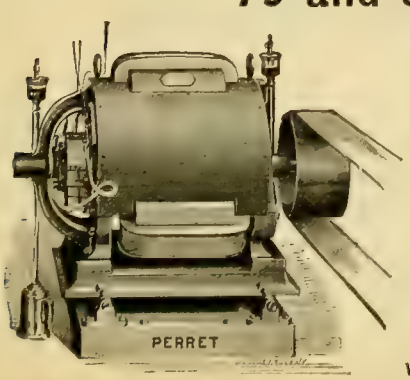

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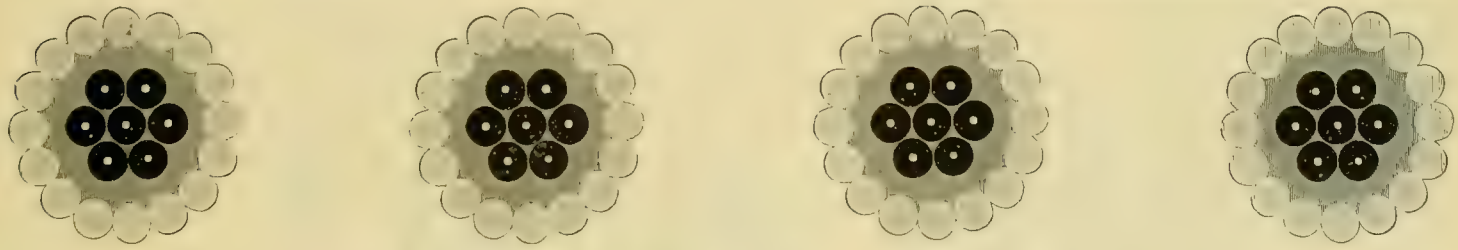

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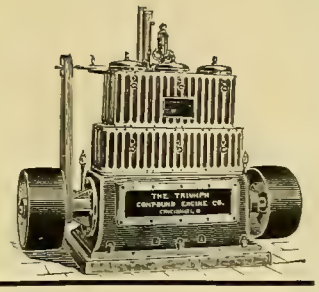

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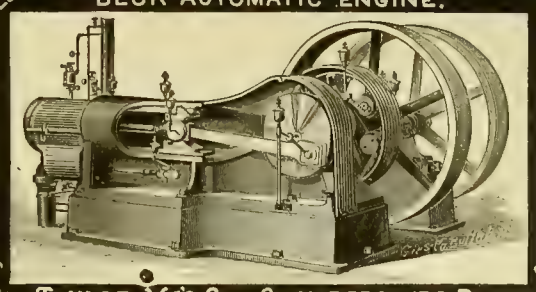

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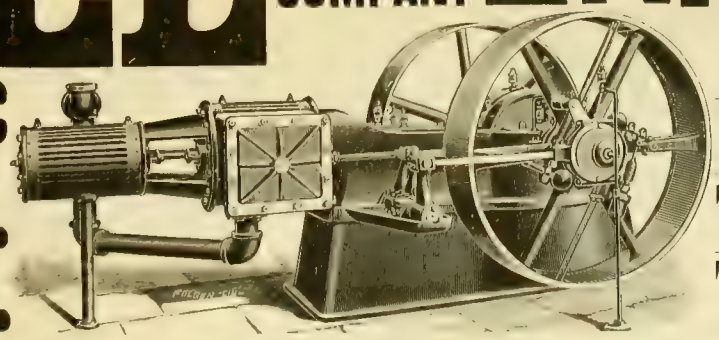

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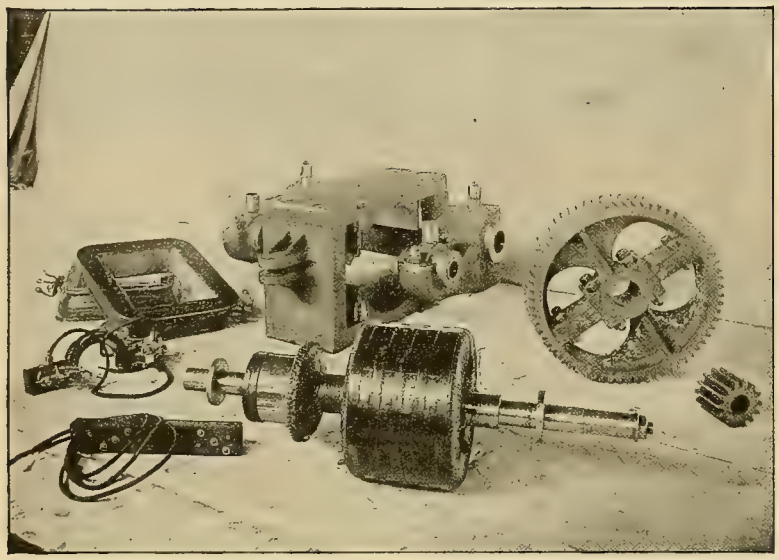

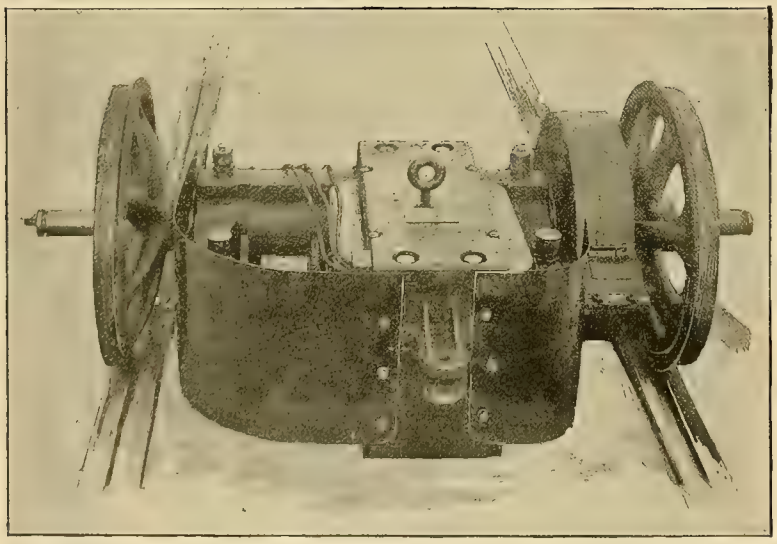

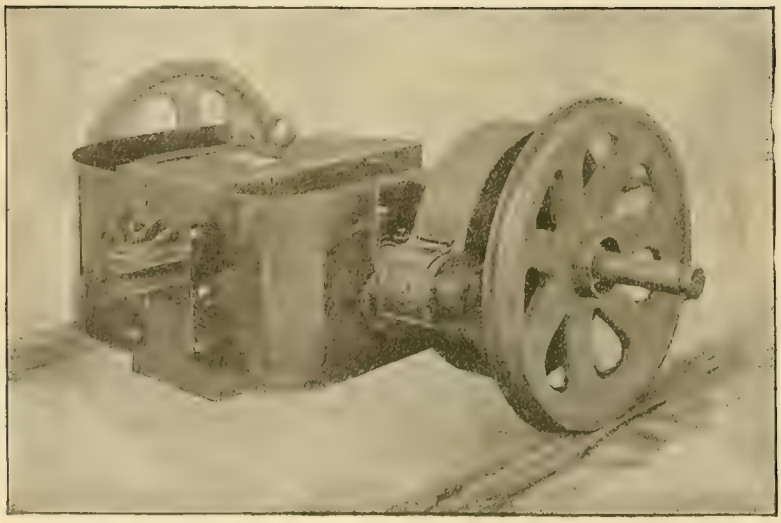

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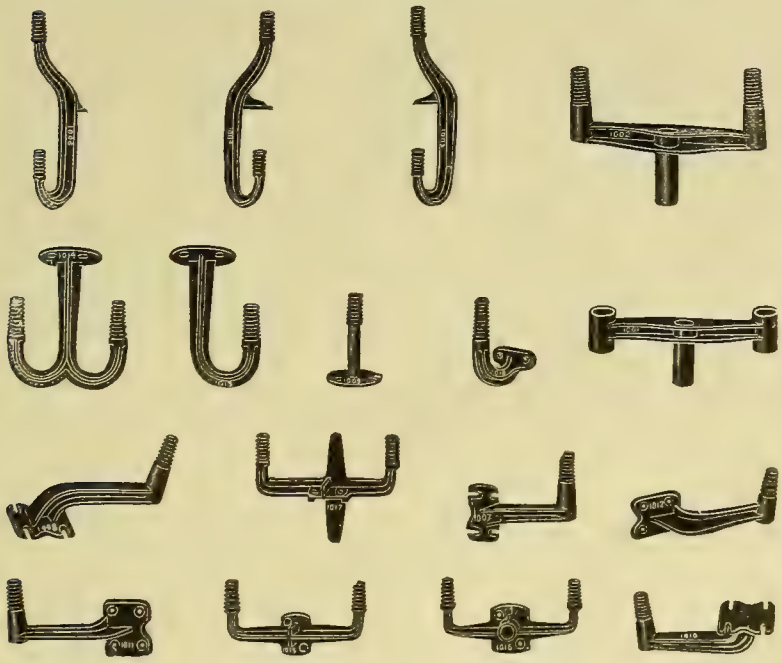

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Respectfully
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THE MOST PERFECT OF ANY.

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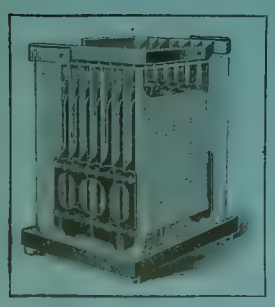

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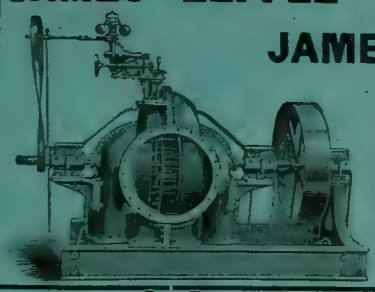

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See Page XXVI.

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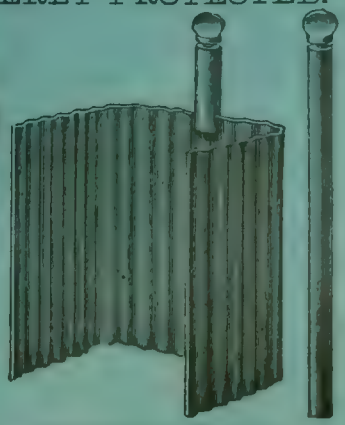

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3,100	NORTH CAROLINA,	1,183
15,555	TOTAL,	1,703

NINE TIMES as many of the Thomson-Houston System as of

ALL OTHERS COMBINED.

The figures referring to "total of all systems," taken from table published in August number of "Electrical Industries," for year 1890, are of undisputed accuracy.	Total of all systems.	Thomson-Houston System.	
		Number.	Percentage to total of all systems.
Montana, - - - -	8,500	8,355	$98\frac{3}{10}$ per cent.
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Partrick & Carter Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

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Turner Brass Works.

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Brush Electric Co.
Easton Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
McLaughlin, Jas.
Mosher Arc Lamp Co.
Schuyler Electric Co.
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Crosby Electric Co.
Electrical Supply Co.,The.
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GreatWestern Electric Supply Co.
Leclanche Battery Co.
Mason, Jas. H.
Monitor Electric Co.
North American Electric Co.
Partrick & Carter Co.
Queen & Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

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Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co., The.
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Partrick & Carter Co.
Queen & Co.
Stanley & Hall.
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Holtzer Cabot Electric Co.
Knapp Electrical Works.
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Standard Electrical Works.
Stanley & Hall.
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Western Electric Co.

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Evans Friction Cone Co.
Ireson, Chas. L.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

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Electrician Publishing Co.

Braider Spoolers.
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Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co.,The E. S.
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Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
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Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
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Engineering Equipment Co.
Hutton, Henry.
McLaughlin, Jas.
Pond Engineering Co.
Temple, J. C.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.
Woodbridge & Turner.

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International Okonite Co., The.
Illinois Electric Material Co.
Knapp Electrical Works.
Monitor Electric Co.
Roebling's Sons Co., Jno. A.
Standard Electrical Works.
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Western Electric Co.

Cross-Arms.
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Monitor Electric Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
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Central Electric Co.
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Fletcher & Fletcher Electric Co.
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Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Paiste, H. T.
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St. Louis Electrical Supply Co.
Southern Electrical Supply Co.
Star Electrix Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
Colburn & Co., I. W.
Easton Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Howard & Co., Hiram.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Palmer Bros.
Schuyler Electric Co.
Shawhan Machine Works.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Star Electrix Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Specialties.
Cutter, Geo.
Hipwell Mfg. Co., H. H.
Northwestern Elect. Specialty Co.
Turner Brass Works.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Thomson-Houston Electric Co.

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Ball Engine Co.
Engineering Equipment Co.
Pond Engineering Co.
Sioux City Engine Works.
Taylor Manufacturing Co.
Triumph Compound Engine Co.
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Electrical Supply Co., The.
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Western Electric Co.
Wollensak, J. F.

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Alexander, Barney & Chapin.
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Illinois Electric Material Co.
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Partrick & Carter Co.
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St. Louis Electrical Supply Co.
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Great Western Electric Supply Co.
Illinois Electric Material Co.
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Standard Paint Co.
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Holmes, Booth & Haydens.
Interior Conduit & Insulation Co.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
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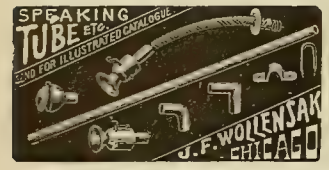

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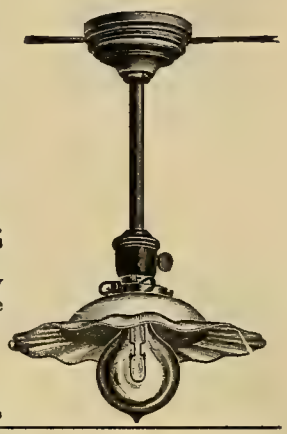

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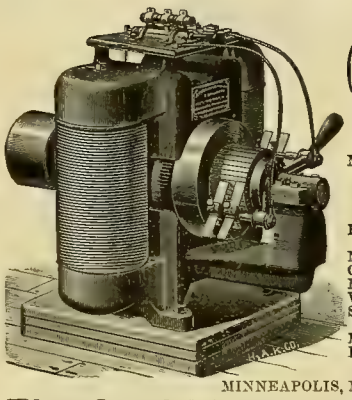

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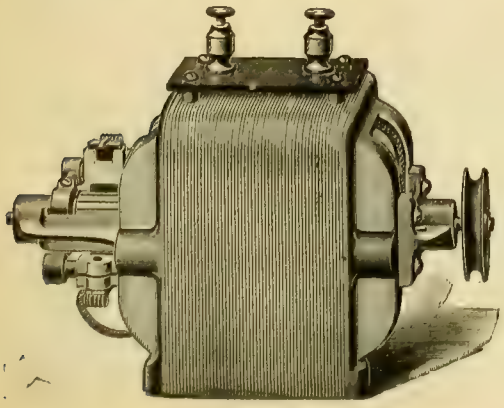

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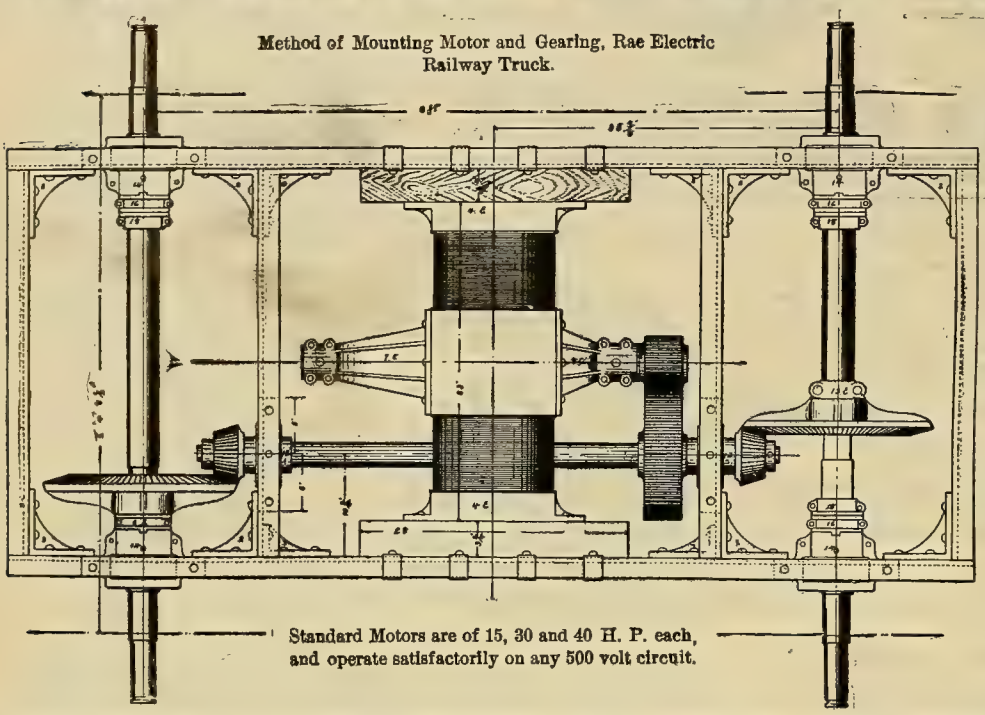

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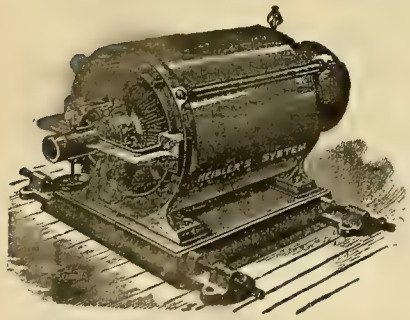

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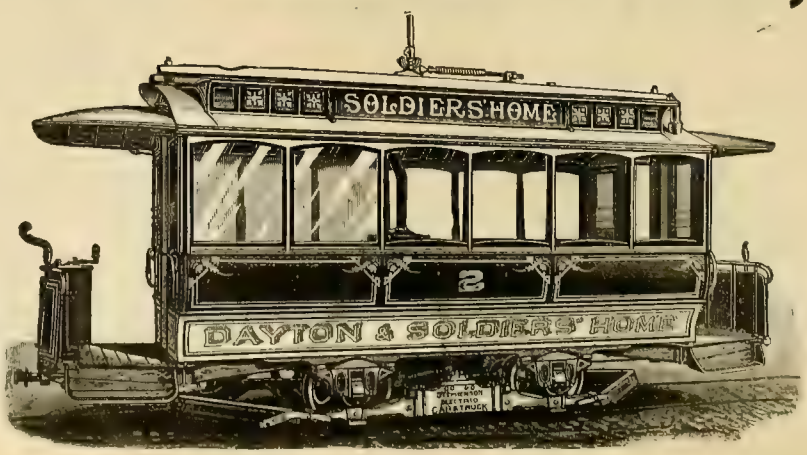

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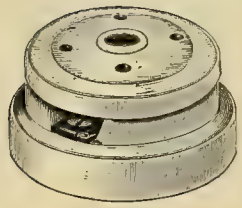

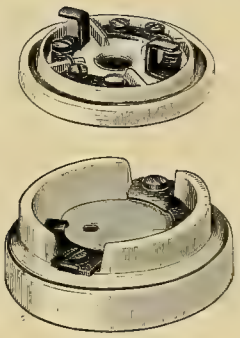

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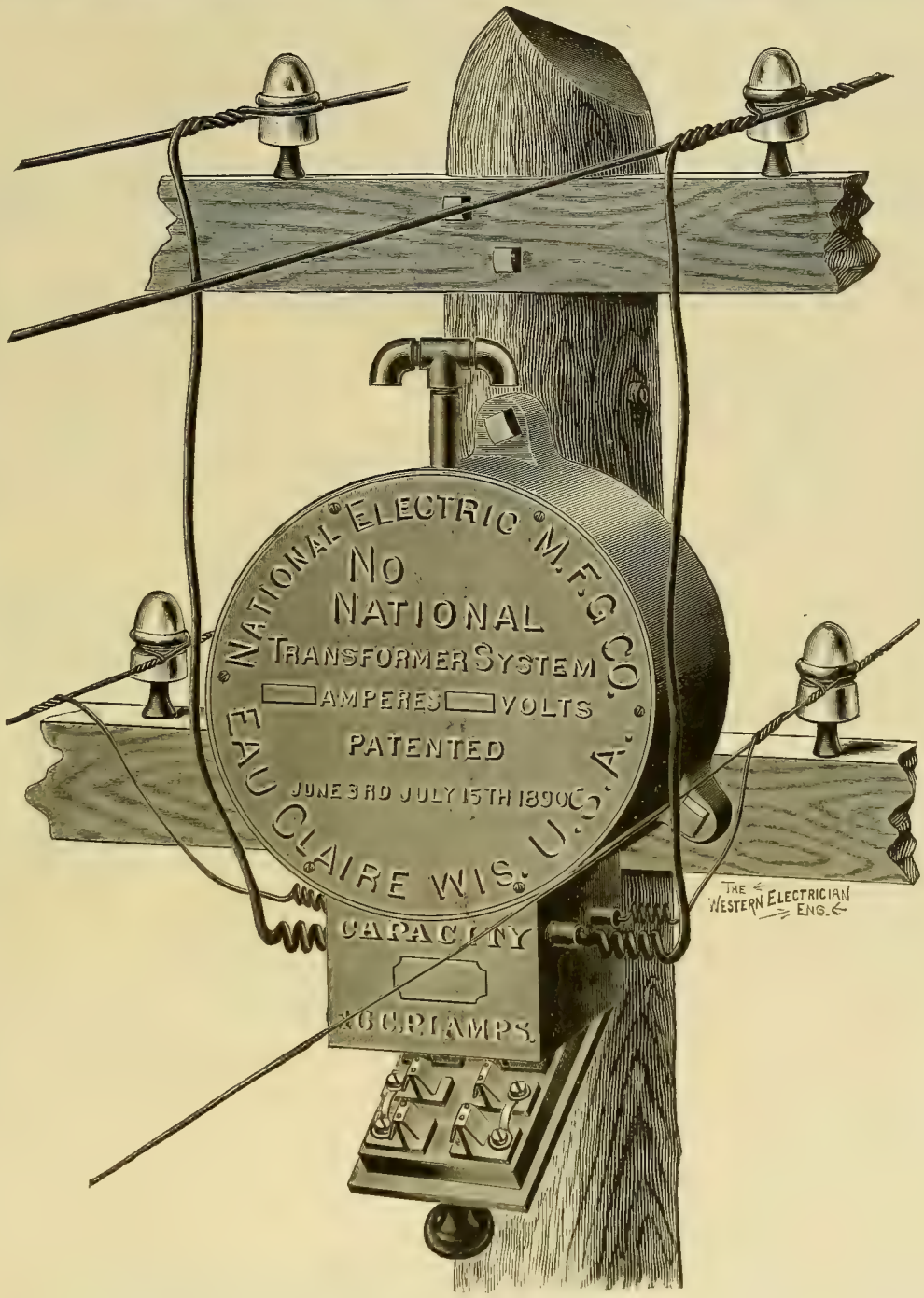

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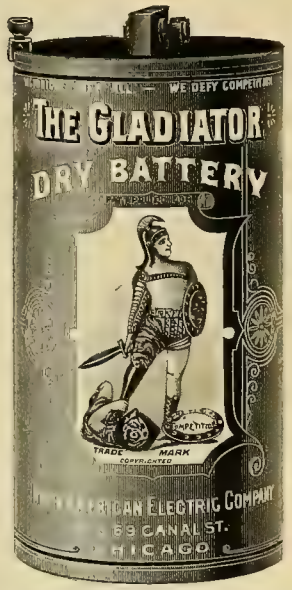

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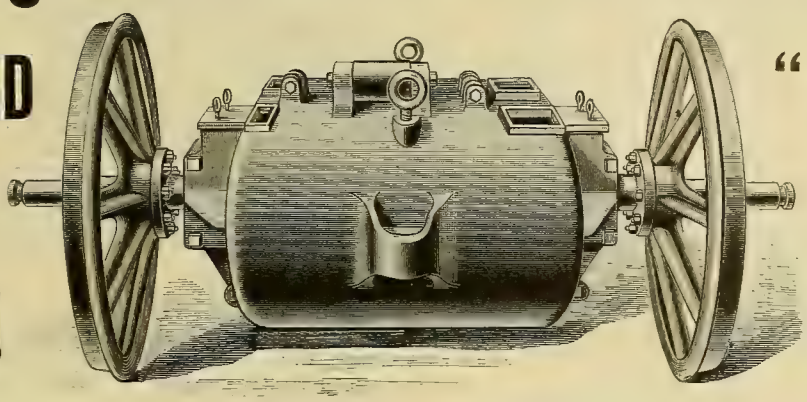

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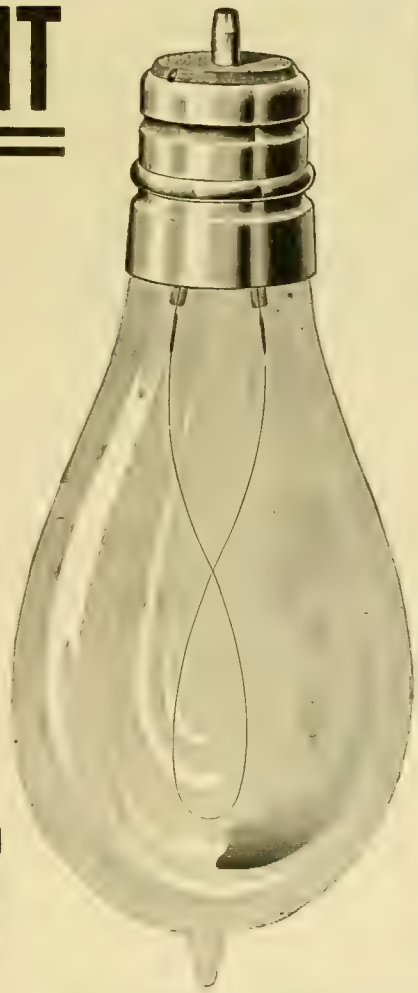

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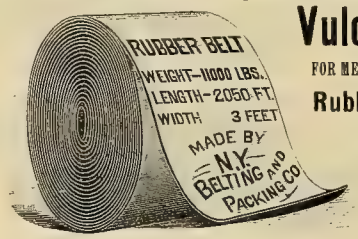

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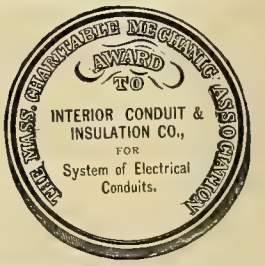

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IT HAS NO EQUAL.

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Burns singly or in series.
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The ARC can be SHORTENED or LENGTHENED IN HALF A MINUTE.
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STATING SYSTEM and VOLTAGE.

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Western Electrician.

EVERY SATURDAY.

Vol. VIII. CHICAGO, APRIL 18, 1891. No 16

William H. McKinlock.

The best illustration of the rapidity with which the electrical business has been developed is the fact that comparatively young men are at the head of the leading electrical establishments. Of course the success which has attended the development of the industry is due largely to the enterprise and ability of these young men. Many of them have devoted their entire attention to the commercial features of the electrical industry, supplying capital for experiments and furnishing the means for exploiting new devices and apparatus. This is especially true in the West, where there are many examples testifying to the superiority of young blood. A notable instance of this kind is shown in the career of the subject of this sketch, William H. McKinlock, whose portrait is herewith presented.

Mr. McKinlock is only 32 years of age, yet he has been engaged in electrical enterprises 14 years. His first experience was with the A. D. T. company at Detroit when 18 years of age. The next year he was made assistant manager of the Detroit Electrical Works, and personally supervised the bookkeeping department. At that time the business of the concern was chiefly manufacturing electro medical instruments, electric bells and burglar alarms. Then came the telephone, which was just making its appearance as a commercial machine. This, of course, stimulated the electrical trade, and the Detroit works engaged in building switch-boards and other apparatus for central office equipments. The enlargement of the business made a reorganization of the company necessary in 1882, and at that time Mr. McKinlock was selected for the position of secretary and business manager. For five years he devoted himself assiduously to the duties of his position, and the business grew accordingly. In 1887, however, Mr. McKinlock, recognizing the superior advantages offered by Chicago, determined to leave Detroit. Accordingly he located at Chicago, and together with his brothers organized the Central Electric company. For a time the business was conducted at 38-40 LaSalle street, the company manufacturing and exploiting electrical devices and conducting a general supply business. The concern prospered from its inception and enlarged its quarters twice in three years. It now occupies the spacious building at 116-118 Franklin street, covering a floor space of 16,000 square feet, where it carries a full line of electrical supplies.

In addition to its Chicago headquarters it has established branches in St. Louis, Kansas City and Omaha, from which points it supplies adjacent territories.

The prosperity of the company and the enlargement of its business has, of course, required several important changes in the original company. Mr. McKinlock, however, remains at the head of the establishment as president, and gives the business his personal attention.

Although Mr. McKinlock was born in Oswego, N. Y., and passed his early days in that city and Buffalo, he is a thorough western man. He believes in the ultimate supremacy of Chicago as the trade center of this country and therefore of the business world. He has taken an active part in World's Fair matters, and believes the great exposition should surpass all former achievements, especially in the electrical display. In this matter he is thoroughly in accord with the position of the Chicago Electric club, of which he is vice-president.

WILLIAM H. M'KINLOCK.

World's Fair Directors.

At the annual election of the stockholders of the World's Columbian Exposition last week two men prominently identified with the electrical interests were chosen directors—R. C. Clowry and B. E. Sunny. Mr. Clowry was a member of the board of directors last year, and Mr. Sunny was one of the new directors selected. Col. Clowry has been in the telegraph service from his boyhood. In 1852 he entered an office in Joliet, Ill., to learn telegraphing, and he has passed through all the grades of this department, until to day he occupies one of the most important positions in the Western Union company. He has entire charge of the business of that corporation in the West, and since 1885 has been acting vice-president of the company. Col. Clowry's headquarters are at Chicago and he will give much of his time to the advancement of the electrical exhibition at the World's Fair. Like Col. Clowry, Mr. Sunny began his electrical work in a telegraph office, in New York City. Three years later he removed to Chicago, continuing in the telegraph business as operator, night manager and manager of the Atlantic & Pacific Telegraph company. When the telephone offered a field for operation Mr. Sunny became superintendent of the operating department of the Bell company's Chicago office, and later, when the Edison company combined with the Bell, he retained the superintendency of the consolidated companies. He was also given charge of the construction department. Mr. Sunny's experience was not confined to telegraphing and telephoning, however, for on January 1, 1888, he was chosen president of the Chicago Arc Light & Power company. He has continued in that position ever since. In December, 1888, Mr. Sunny also became identified with the Thomson-Houston Electric company, and he is at present manager of the western department of that corporation, with headquarters at Chicago. Mr. Sunny is still a young man, but he has displayed executive ability of a high order, and all of his business ventures have proved successful. He has taken a leading part in advancing the interests of the World's Fair, and as chairman of the committee of the Chicago Electric club on World's Fair matters has shown himself thoroughly familiar with the requirements of the electrical department.

In Mr. Sunny's election to the board of directors the electrical interests have secured another able friend, in whom they can place implicit reliance.

Firemen and Overhead Wires.

The Municipal Electric Lighting & Power company, St. Louis, has complained that the wires of its plant and other wires are sometimes cut indiscriminately during the progress of fires, and the electric lighting company has arranged to send a wagon, manned by electricians and equipped with all necessary appliances for handling wires, to fires that occur in the district bounded by Franklin avenue and Elm street, Eleventh street and the river. As yet, however, the arrangements of the electric lighting company are for attending fires on second alarms only. Chief Lindsay is not disposed to favor this idea, and he wants the company to respond to the first alarms, if at all, as he says that when it becomes necessary to cut wires the first five minutes of a fire is the time that the fire department can least afford to lose. This is particularly the case when ladders are to be raised to tall buildings, especially for the purpose of saving life. The chief says that he considers the assertion of the company that the wires have been cut unnecessarily as superfluous. The members of the fire department, he says, are not anxious to be assigned to the work of cutting wires. The department has been furnished with the best insulated tools that are made, to be used in such emergencies.

The King of Wurtemberg has bestowed the gold medal for art and science upon Paul Reisser, a noted Stuttgart electrician. Mr. Reisser is one of the pioneers of electric lighting in Germany. He has successfully carried out a large number of public and private installations in every part of Wurtemberg, and the electric lighting of the royal residence at Friedrichshafen is under his personal charge.

Electric Light Plant in the Capitol at Washington, D. C.

Probably no building in the country is the object of so much attention as the capitol at Washington, D. C. It is visited annually by many thousand sight-seers, and contains many attractions in addition to the interest that is attached to it from the fact that it is the meeting place of the highest legislative body in the country.

It is probable that more money has been expended upon it than any other building in the country. In many respects it is a model structure, its ventilating system being the most complete that has yet been devised. In this system electric motors for operating fans and blowers are employed. Current is supplied for these motors from the electric light plants in the basement.

The Westinghouse Electric company installed plants in both the house and senate wings and leased them to the government, the latter paying an annual rental and defraying all the expenses including salaries of employes. This places the machines practically in the possession of the government.

The plant which supplies light in the south wing, or, more properly speaking, the hall of the House of Representatives, consists of one 750 light dynamo made by the United States Electric Lighting company. The machine is of the regular 110 volt type, shunt wound, and is driven by a Westinghouse standard engine of 80 horse power capacity. Steam is furnished from a Babcock & Wilcox boiler of 80 horse power. The dynamo is belted directly to the engine. At the present time current is supplied to more than 650 lights, and during the summer months there are a number of ventilating fans in committee rooms operated by electric motors.

The switch-board is supplied with the necessary measurement instruments, etc. A view of this dynamo room is shown in Fig. 1.

Fig. 2 gives an excellent idea of the plant which supplies the lights in the north wing. It consists of two Westinghouse alternating current machines, 650 lights each, with two exciters, each machine being belted directly to an 80-horse power Westinghouse standard engine.

The current obtained from these machines is used in lighting the senate wing and the committee rooms, and during the summer a large number of ventilating fans are run from alternating current motors. The fixtures in the committee rooms are of very elaborate designs.

The switch-board is made of cherry, and the different instruments necessary for the proper operation of the plant are conveniently distributed over it, as will be seen by reference to the cut. The entire plant is under the supervision of C. P. Gliem.

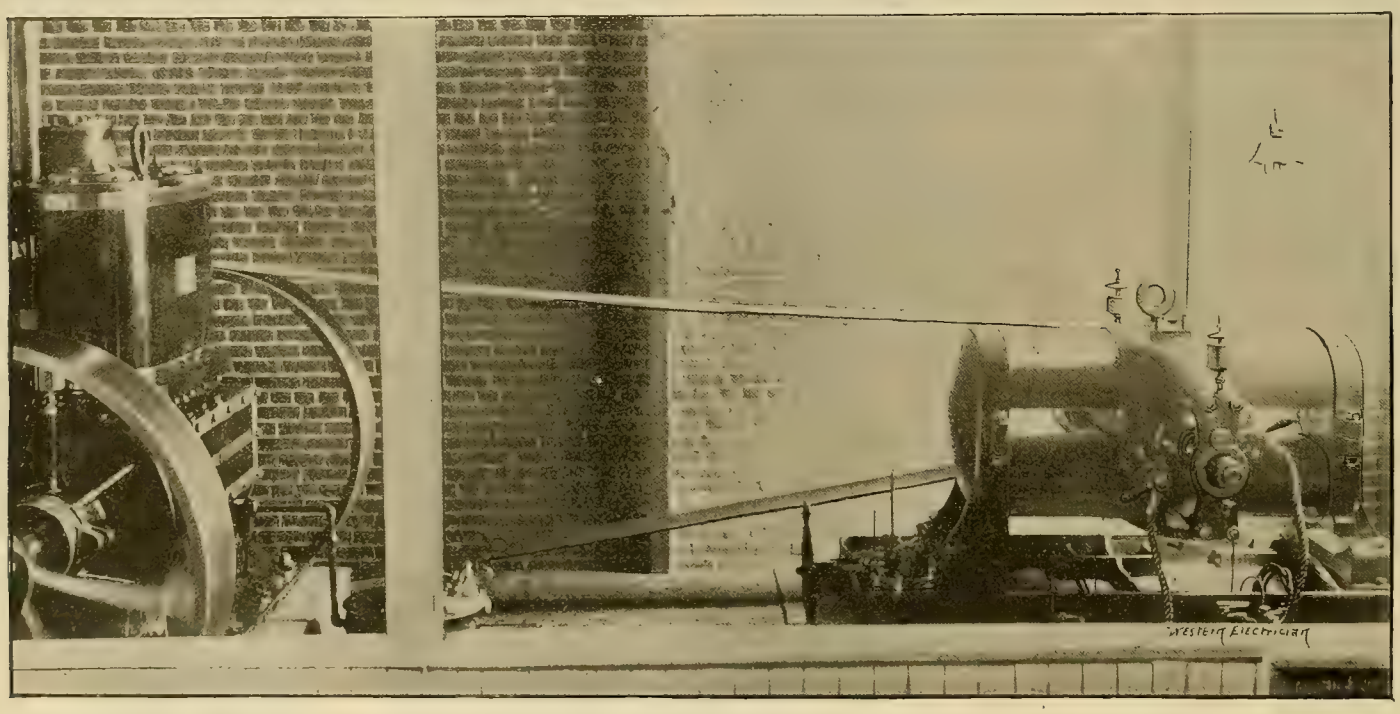


FIG. 1. ELECTRIC LIGHT PLANT IN THE CAPITOL AT WASHINGTON, D. C.

Adams' Railway System and the World's Fair.

Much interest has been manifested in the subject of transportation at the World's Fair by electric railway companies, and several schemes have been proposed for the establishment of a system of electric railways at the exposition grounds. Considerable surprise was experienced, therefore, when it was announced in the Chicago daily papers that the construction department of the exposition had decided to recommend the Adams Electric Railway system, recently illustrated in the WESTERN ELECTRICIAN. In order to secure authoritative information on the subject, the WESTERN ELECTRICIAN communicated with the construction department, and secured from Engineer Gottlieb a positive denial "that the department had recommended or agreed to recommend the adoption of the Adams system" or any other system for the exposition. Mr. Gottlieb said that the competition was still open "for all systems of elevated roads operated by electricity or any other way." It would appear from this that surface roads would not be adopted under any consideration.

Mr. Gottlieb adds: "The Adams company, so far as I know, has never built any road according to their system, nor have they built any trial section for experiments."

It is certainly to be regretted that only elevated systems will be considered, as the exposition would afford an excellent opportunity to display the superiority of the electric road as it is commonly installed—a surface line on the overhead trolley system. The construction department, it is hoped, will not adopt any system of electric propulsion that may not be recognized by the electrical fraternity as a representative system. It should be required that the system adopted should have demonstrated by practical work that it is commercially successful, and can fairly represent the electric railway interests. There will be plenty of opportunities to display experimental roads in the electrical department. There must be no failure in the system adopted for transportation of passengers about the grounds of the exposition.

In the case of the Electric Improvement company of San Francisco against the city, Judge Hawley of the United States Court has granted a decision dismissing the complaint and dissolving the temporary injunction. The action grew out of an ordinance passed by the board of supervisors prohibiting the suspension of electric light wires over the roofs of buildings. The ordinance had no sooner become a law than the Electric Improvement company began an action to prevent its enforcement and to prevent Chief Scannell from removing the wires as directed. Judge Hawley, in his opinion, holds that the ordinance is valid and is only the exercise of the police powers of the municipality.

Increasing the Durability of Incandescent Lamp Filaments.

The most frequently employed method of manufacturing filaments for incandescent lamps consists in causing the carbonized filaments taken from the furnace to glow within an atmosphere of some hydrocarbon, thus causing more carbon to be deposited upon the filaments. These filaments, however, suffer from certain defects, the diminution of which is desirable. One defect, for instance, is that the deposited carbon layer is eventually removed through the influence of the current, so that the filament deteriorates very materially after a certain time. Another great defect in this method of manufacture arises from the fact that the carbon layer being of very good conductivity, considerably diminishes in consequence the resistance of the carbon filament, necessitating the use of very thin carbon filaments and very thin layers of deposited carbon, in order to obtain a glowing substance of conveniently high resistance. In order to produce a filament in which these defects would not exist several new processes have lately been devised.

F. G. A. Heller of Berlin, Germany, announces that it has been found that if carbon filaments be covered with a layer of such metals as will melt only with difficulty and whose melting point is high enough to allow them to resist easily such temperatures as occur in incandescent lamps, the cohesion of these particles with the inner filaments, and at the same time between themselves, will be a strong one. He finds that this cohesion makes itself felt against the influences attacking the durability of a filament as well as against those influences which eventually bring about the dispersion of the particles and their settling on the glass bulbs. The metal chromium he has found to give the most satisfactory results under the various conditions to which the filaments are subjected. The metallic covering may be obtained in different manners, either by the purely electrolytic process or by the chemical method through reduction of a metallic salt upon the carbon filament.

Another inventor, George Erlwein, also of Berlin, Germany, has recently described several somewhat similar methods by which he proposes to improve the durability of the filaments. In one process he employs nitrides of silicon and boron. These substances remain stable at the highest temperatures and therefore prove specially suited for this purpose. Various processes for the production and deposit of these compounds are well known to chemists; but Mr. Erlwein prefers to heat the ordinary carbon filaments to incandescence within an atmos-

phere of volatile silicon compounds and volatile nitrogen compounds. The required heat is obtained by passing the electric current through the carbon filament. The silicon compounds in contact with the filament are reduced by the heat and form with the nitrogen of the ammonia solid nitrides of silicon, which are deposited nearly uniformly over the surface of the carbon filament.

In another method Mr. Erlwein employs hardly fusible metallic phosphides. The phosphides are obtained in the usual manner by a gradually increased heating to incandesence in phosphorous vapor of the filaments already provided with metallic coatings, or this may also be done in many instances by having the filaments soaked in chlorides or oxides and heated in phosphoreted hydrogen or in phosphine. Among the metals suitable for this purpose may be mentioned iron, platinum, iridium, palladium, molybdenum, chromium, manganese and tungsten, the preference being given to iron.

Prof. Varley's Proposition.

Chief Barrett of the Department of Electricity of the World's Fair receives many interesting documents from inventors and cranks. Some of these are highly amusing. Among the propositions now on file in Chief Barrett's office is the following unique communication from Prof. Varley, of London, which accompanied the photograph of his "original dynamo" illustrated in a recent issue of the WESTERN ELECTRICIAN:

My name is not altogether unknown in America, and I think I may say with truth that there is no living Englishman who has done so much in the way of originating and pioneering electrical advances as myself. When a young man, in 1858 and 1859, I showed the practical bearing of electrical theory to submarine telegraphy in papers read by me before our Institution of Civil Engineers and the Society of Arts, and in opposition to all our physicists, including the late C. F. Varley and Sir William Thomson.

In 1859 I publ'shed a description of artificial submarine circuits, which I had designed and which have since enabled submarine circuits to be duplexed.

In 1866 I introduced the greatest improvement effected in the Wheatstone needle telegraph.

In 1866 I discovered the dynamo principle and constructed the first self-exciting dynamo, and for having done so I was awarded, 19 years later (1885), the gold medal of our Inventions Exhibition, and since then two legal decisions, given in 1889 and 1890, have awarded me the credit of being the first to design a compound wound dynamo, my patents having been taken out in 1876 and that of Brush in this country in 1878.

Owing to my persevering exertions, given almost entirely gratuitously, the electrical industry of this country has not been paying royalties to the Anglo-Brush corporation since 1888, and, what is really of more importance to the industry, the Brush company has been stopped obtaining a prolongation of its patents which, but for myself, assisted as the Brush company is, by the attorney-general, Sir William Thomson and others, it would most likely have obtained.

Like many other originators I have been very inadequately rewarded for what I have succeeded in accomplishing, and it has been my fate to have been very peculiarly circumstanced. I had a very brilliant elder brother, the late C. F. Varley, who obtained the professional indorsements and to a large degree also the scientific credit of my work. The papers read by me in 1858 and 1859 led at once to my brother being appointed chief electrician of the old telegraph company and also that of the Atlantic Telegraph company. After that he joined forces with Sir William Thomson, and very profitable it was to both of them. At one time I think my late brother was the most foremost electrical engineer in the whole world, but he was very jealous and grasping. Brilliant he undoubtedly was, but he was not nearly so original as he was credited with being. In the matter of jealousy he was in a sense absolutely mad, and with all his worldly prosperity he was a most unhappy minded man.

The making an absolute monopoly of the telegraph was most disastrous to my fortunes. The electrical department of the post office, in its first telegraph report, took the credit to itself of my invention in connection with the needle telegraph, describing it as the greatest improvement effected on Wheatstone's original invention, and behaved in such a way toward me as to close my factory, and by doing so, took away my right hand, at the most important epoch in my life, and I was prevented taking any active part in the development of the dynamo electric industry, being in part invalided in the struggle I made at that period.

There has been money in all that I have pioneered, and apart from having constructed the first self-exciting dynamo, three separate fortunes have been made by others out of work I have originated.

There is more enterprise in America than in the old country, and there is, I believe, a large exhibition to be held in Chicago next year, and I am informed that you are actively connected with it.

Now a prophet has no honor in his own country, but honor is often awarded him elsewhere, and it has occurred to me that as I possess the original dynamo, and it is in working order, that this machine and myself in connection with it might be an attraction.

Had it been my good fortune to have met with a commercial capitalist who would have put money on me I should have made his and my own fortune again and again, and there is good deal of work left in me still.

Now I should be quite ready to entertain an offer and to come over to America if it were only made worth my while. In any case I have thought I could do no harm in writing. The pamphlets I forward you will bear evidence that I am an earnest, original and practical scientific worker.

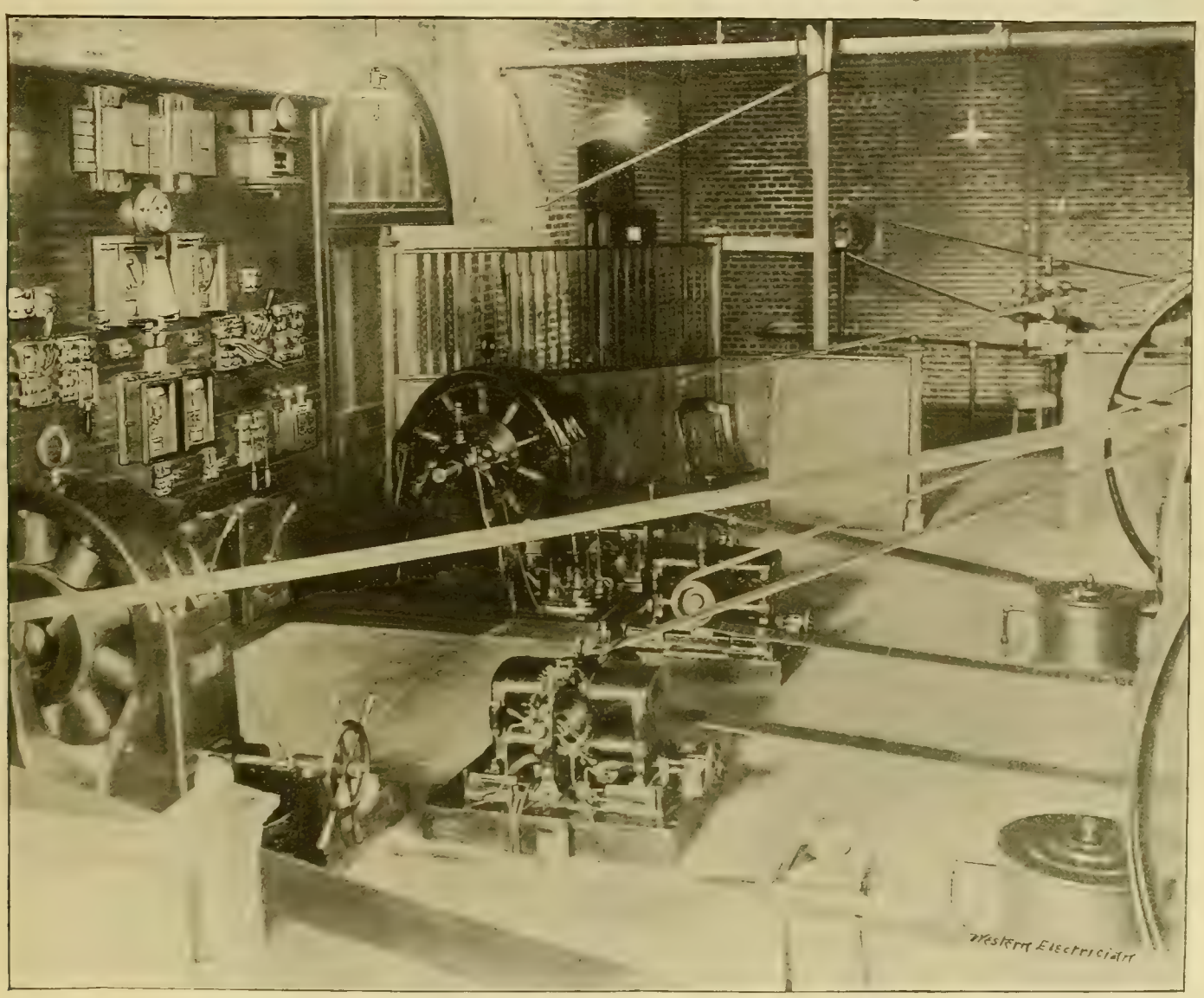


FIG. 2. ELECTRIC LIGHT PLANT IN THE CAPITOL AT WASHINGTON, D. C.

The Electric Arc.

To the WESTERN ELECTRICIAN:

On page 114 of your valuable publication there is stated in the article by Prof. E. Thomson: "Dr. T. A. Fleming has recently shown that the difference of potential between the positive carbon and the arc flame is about forty volts and the few volts which express the difference between the flame and the negative make up the total potential, say forty-five volts." Allow me to call your attention in regard to this that Dr. Fleming has not discovered or called attention to this fact but that I have done so myself, I have published my investigations in the *Centralblatt fur Elektrotechnik*, Vol. X, No. 104, in an article dated January, 1888. Similar investigations were also carried on at about the same time by Dr. Lecher. Dr. Fleming seems to have no knowledge of these investigations. Respectfully yours,

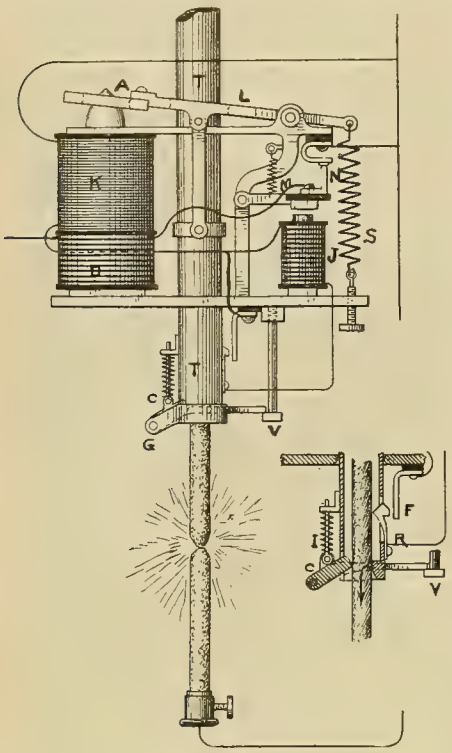
L. UPPENBORN.

BERLIN, March 17, 1891.

Arc Lamp.

The arc lamp illustrated diagrammatically in the cut is the invention of Prof. Elihu Thomson and E. W. Rice of Lynn, Mass.

The novel feature claimed for the lamp is the method of feeding the carbon by means of a device acting directly upon the pencil instead of

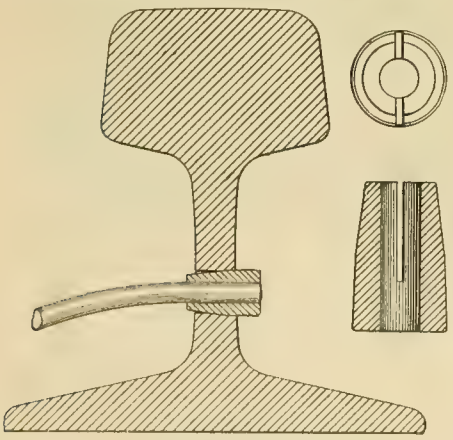


ARC LAMP.

upon the metallic rod to which the carbons in most arc lamps are attached.

Referring to the cuts the general arrangement of the mechanism will be understood. *K D* is a magnet composed of a coarse wire coil *D* and a fine wire coil *K*. An armature *A* carried by a lever *L* serves to raise and lower a vertical tube *T*. Attached to the lower end of tube *T* is a clutch mechanism *G*. This clutch consists essentially of a movable cam *C* fixed so as to be released by a stop *V*. The cam clutches, as shown, the pencil through the agency of the spring *I*. Magnet *J*, when energized, opens a contact *N* against the force of a retractile spring.

The operation of the lamp is as follows:



WHEELER'S CONNECTOR.

With no current flowing, the parts are in the position shown in the cut; that is, the clutch and tube *T* have been elevated by the spring *S* and its connection. The carbon is held up by the clutch, so that no contact with the lower pencil exists. The arm of the clutch is lifted off its releasing stop *V*. The contact at *N* is closed. Upon the passage of the current it finds least resistance through the coil *D* and contacts *N*, which form the starting branch. The main magnet is now energized and attracts its armature *A*, moving the latter so as to release the clutch *G*, and cause the upper carbon to drop into contact with the lower. At this moment the current passes through the small magnet *J* to the tube *T*, and thence through the carbons and out of the lamp. The small magnet *J* being thus energized attracts its armature, opening the contact at *N*. The branch through *D* is now interrupted, and the coil is thrown out of action. The armature *A* now rises under the action of the spring and separates the carbons until the retractile force of the spring *S* is balanced by the increased influence of the current in the derived circuit *K*.

From the above it will be seen that as the carbons burn the force of the magnet *K D* will continue to increase and attract the armature *A*, so as to finally again feed the carbons by the release of the clutch *G* upon the downward motion of the latter. It will be noticed also that in the movements of regulation the tube and clutch move as one piece, except at the moment of feeding.

A special advantage claimed for the mechanism of this lamp is the reduction of friction, due to the fact that the tube *T* moves simply in its guides during regulation, while the parts carried by it are, relatively to it, at rest, except, as before stated, at the moment of feeding.

Wheeler's Connector.

The accompanying cut illustrates an improved form of connector to be used in electric railway work to attach the supplementary wire to the rail. This improved connector is the invention of G. K. Wheeler of the Western department of the Thomson-Houston company, Chicago. A glance at the illustration will give the reader a good idea of the device. To attach the wire to the rail, it is first passed through the hole in the rail, and then the spool is passed over its free end and driven into the opening. The driving in of the connector causes the spring-jaws to clamp the wire firmly, and at the same time establishes a good electrical connection, which, it is stated, does not become deteriorated by oxidation. As the head of the spool is uncut, it can be driven into the rail with little danger of breakage.

Underground Conduit for Electric Railways.

Perhaps the chief objection that has heretofore been urged against the employment of underground conduits for conductors in electric railway systems has been the difficulty in protecting the wires from surface water. Nearly all authorities on electricity are agreed that, at the present time, the conduit system appears to be the most desirable of all, could this difficulty be overcome. With the idea of eliminating this objection Capt. William Bradley of Fort Wayne, Ind., has invented the form of conduit shown in the accompanying illustrations.

The leading idea embodied in the system, and the one on which the principal claim is based, is very simple. It is that of having the opening into the conduit at the side instead of on top. This is accomplished by constructing the conduit in the manner indicated in Fig. 1. The side plate, which can be easily and quickly removed at any time, projects in the form of a lip over the upward curved portion of the conduit,

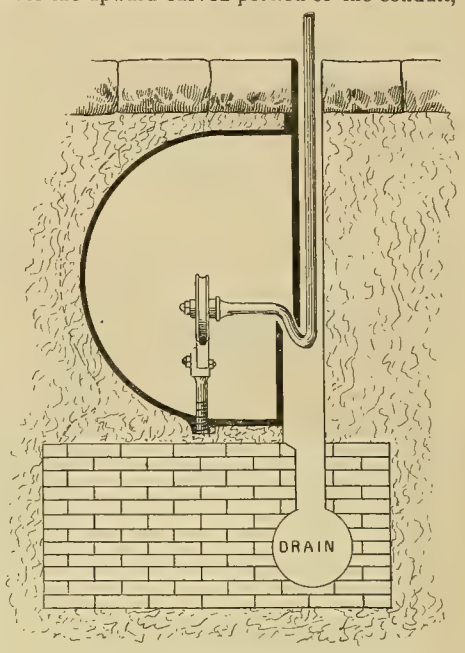


FIG. 2. UNDERGROUND CONDUIT FOR ELECTRIC RAILWAYS.

thus rendering it impossible for water or mud to enter the conduit, as will be readily seen by a reference to the sectional view shown in Fig. 2. As will also be noticed, a drainage chamber, below the level of the conduit, is provided, from which surface water can easily be carried off by laterals leading to the street sewer. It has been calculated that this drainage chamber can carry away more water than can possibly find its way into it during the heaviest rainfall.

As shown in Fig. 2 the trolley rod is curved in such a manner as to permit its passage under the guard plate and into the conduit, where it supports the trolley-wheel on the conductor. The interior of the conduit is to be lined with tarred canvas to prevent the condensation of moisture on the surface of the iron and the trolley wire is to be supported on insulators of compresssd paper, also shown in Fig. 1.

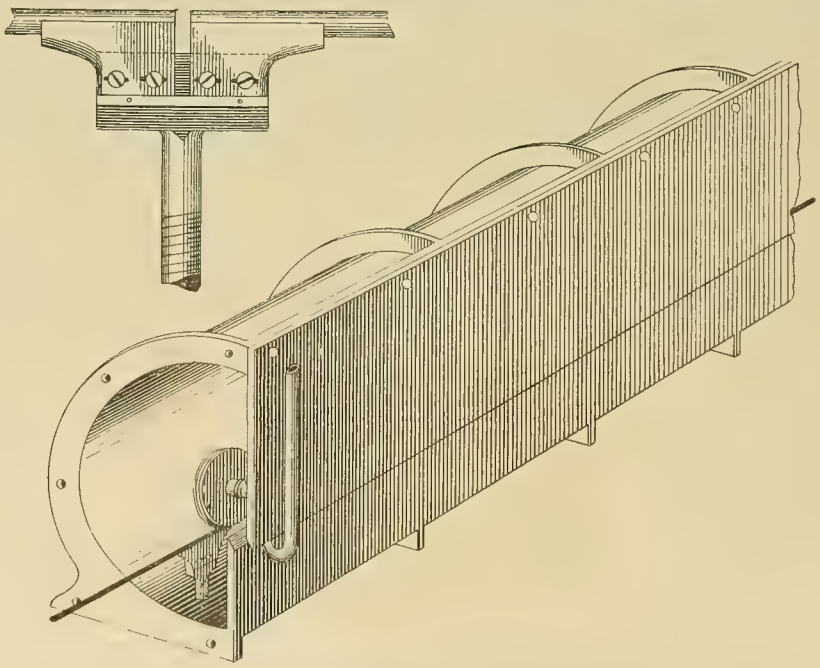
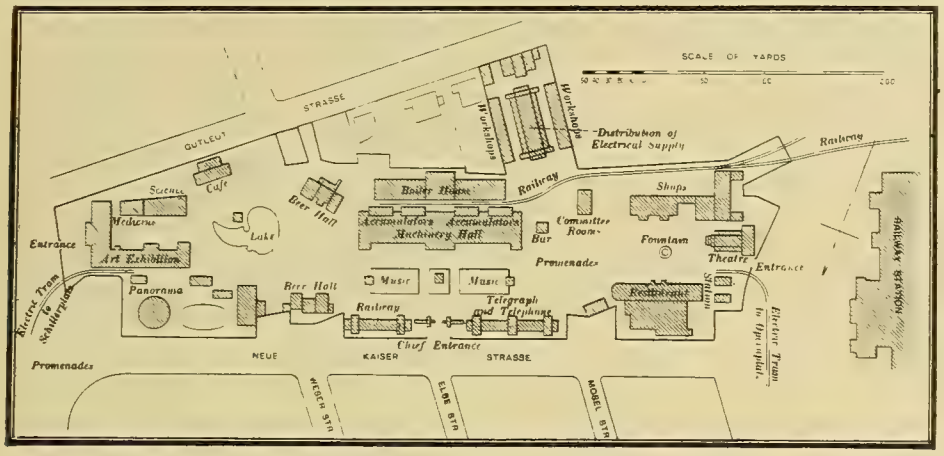


FIG. 1. UNDERGROUND CONDUIT FOR ELECTRIC RAILWAYS.

George J. E. Mayer has charge of the invention in Chicago, and is organizing a stock company to exploit it.

International Electrical Exhibition at Frankfort, Germany.

The great attraction afforded by the department of the Paris exhibition dealing with electricity and its industrial applications, seems, says the London *Electrician*, to have suggested the idea of holding an international electrical exhibition in Germany. The scheme found all the more favor from the fact that at Paris the German electrical industry was not adequately represented. A proposal to undertake the exhibition last year fell to the ground, as the notice given was too short, and it was accordingly determined to defer it until 1891. Considerable anxiety was naturally felt lest the great firms and the capital itself would look with jealousy on an exhibition of such magnitude held away from Berlin. These fears have proved groundless, however, and the decision of Frankfort to undertake and promote the exhibition has been received on all sides enthusiastically.



INTERNATIONAL ELECTRICAL EXHIBITION AT FRANKFORT, GERMANY.

It is certain that the first sight a visitor to Frankfort this year will have will be the exhibition, for it lies directly opposite the railway station. The site chosen for the building is very advantageous. The railway station, one of the finest and most imposing on the continent, is separated from the chief part of the town by a large open piece of ground over which the lines used to run to the old railway station, which was farther in the town. This space happened, luckily, this year to be still unoccupied, and the owners have liberally placed the south side at the disposal of the promoters of the exhibition. Here the buildings are rapidly rising, and some 300 workmen are busily engaged. The exhibits will, as far as possible, be classified not so much according to firms, but according to the technical head under which they fall. Thus, there is a great machinery hall, forming the central part of the exhibition, behind which the boilers will be found in a separate house. Telegraphy and telephony, model electric light installations, electro-chemistry and all possible branches of electro-technology will have their separate departments and in many cases separate buildings.

The machinery hall is very nearly ready, and preparations are already being made and foundations laid for the reception of the machines. In the boiler house four boilers are now being laid down, three from Paucksel of Landsberg and one from Berningshaus of Dursburg, the last working at a pressure of twelve atmospheres. There will be in all twenty of different kinds, with 2,400 square metres heating surface. The total power developed by the motors in the machinery hall will reach over 4,000 horse power, the separate motors varying from one-half-horse power to 600 horse power. The number and variety of dynamos shown at the exhibition promises to be very large. Altogether, in the machinery hall and boiler-house sixty firms will be represented, of whom twenty-two will exhibit dynamos. The direct current machines will require 600-horse power, while the alternators will require 400-horse power. Accumulators will be found at the back of the machinery hall. Six firms are exhibiting, and the power available from this source will be 400-horse power. A building on the right of the machinery hall, but lying farther back, will be devoted to the display of the various methods by which the electric current is supplied in the streets of a town. Other buildings on the right of the machinery hall are devoted to materials and appliances for electric lighting. There will be seven shops electrically lighted and a theater, where the visitor will have the opportunity of hearing operas telephoned from Wiesbaden and Munich.

There will be four different kinds of electric railways connecting the exhibition with the Opera house, the Schiller platz, which is in the center of the town, and the Main. A tower will be erected by the river, on which large reflectors and powerful electric lights will be provided. Excursions on the river by electric launches will add to the numerous entertainments provided for the visitors. A large grotto, lighted with glow lamps, is also being built. A captive balloon is announced, which from its novelty is sure to awaken considerable interest. It is to ascend to a height of 600 metres, and experiments are being made for preparing the necessary hydrogen by electrical means. The electrical transmission of power will be strikingly illustrated by the application of water-power developed at Lauffen, on the Neckar, for driving machines, or giving electric light at the exhibition. The distance is about 100 miles, and the water-power at Lauffen 300-horse power. Of this only two per cent. is to be lost in the transmission. A pressure of 20,000 volts will be used. The cable will be made by Siemens Bros. of London. The interest which is taken in this particular project in the highest quarters has just been shown by a gift of 10,000 marks from the emperor himself and a similar one from the Frankfort chamber of commerce. In addition, power will be electrically transmitted from Offenbach—about five miles—and from a steam engine in the Palm gardens at the north side of the town. Twenty-two workshops of different trades are being set up in the exhibition, having their lathes and other machines driven by electric motors, varying from one-twentieth horse power to six horse power. The accompanying plan will give some idea of the size and relative position of the buildings.

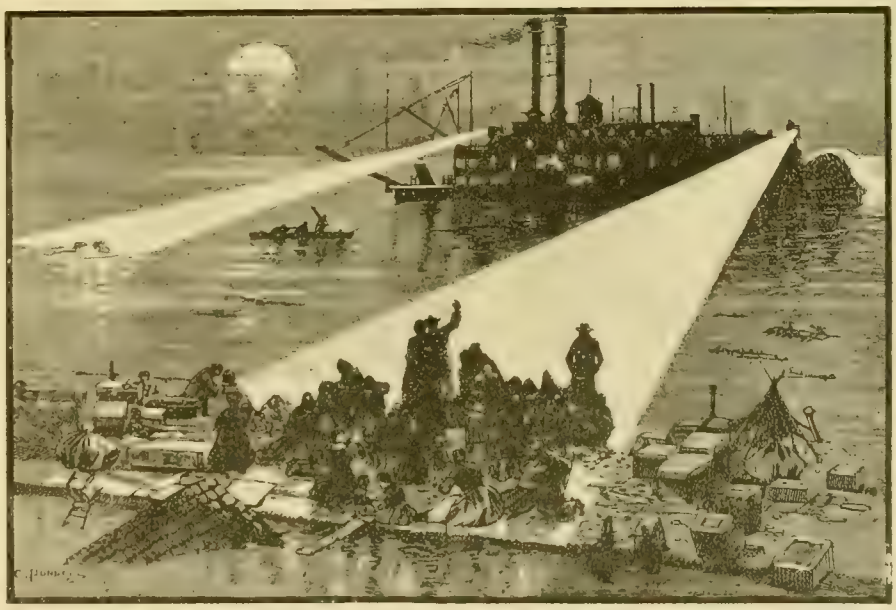
The list of names forming the organizing body numbers more than 150. The honorary presidents are Finance Minister Dr. Miguel and Herr Heldberg, the postmaster-general of Frankfort. Then come as honorary members Dr. Werner von Siemens, Professor A. von Waltenhofen, Professor Silvanus P. Thompson, Marcel Deprez and Thomas A. Ed son. The chairman of the committee is Herr Leopold Sonneman, and the honorary secretary is Carl Stiebel. The exhibition, it is expected, will be opened by the emperor on May 16th, and will be closed some time during October.

Electricity in Warfare.

Dr. R. F. Gatling, the inventor of the gun which bears his name, attended the convention of inventors at Washington last week. He does not think that the limit has been reached in the development of ordnance capable of killing the greatest number of men with the least effort. If some one could invent a powerful electrical machine that would kill whole armies by the mere turning of a switch, he said, there would not be a monarch in the world who would go to war. He could not force soldiers to enlist if every man was certain of meeting death. It is the chance of escap ng death and earning honor, fame, and glory that makes the soldier willing to face the enemy. Each man believes that it will be his comrade and not himself who will be left dead or wounded on the field.

Electric Search Lights in the Mississippi Floods.

During the recent flood in the Mississippi Valley many families were forced to leave their homes to escape drowning. Their houses were submerged, and in many cases when they found it impossible to remain even on the roof they sought temporary shelter on improvised rafts, until they were picked up by the river steamboats. The work of rescuing these unfortunate people was continued at night as well as during the day, the captains of the river boats using their powerful electric search lights to discover the victims who were floating about helplessly on rafts, or shivering on housetops. The accompanying illustration, reproduced from *Once a Week*, shows a night scene and the manner in which the rescuing parties worked by the aid of the electric search light.



ELECTRIC SEARCH LIGHTS IN THE MISSISSIPPI FLOODS.

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J. B. O'HARA, - - - - - - - - - - - -
F. L. PERRY, - - - - - - - - - -Associate Editors.
W. E. KEILY, - - - - - - - - - -

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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DURING the last three weeks the representatives of the electrical interests have been endeavoring to secure from the construction department of the World's Columbian Exposition a reconsideration of the plans for the electrical building. This action was demanded immediately on the announcement in the WESTERN ELECTRICIAN of the provisions for the electrical display as proposed by the construction department. The Chicago Electric club entered a formal protest against the adoption of the plans on the ground that the provisions were inadequate, and that it would be necessary to divide the display. Chief Barrett of the department of electricity was sick at the time, but as soon as he was able to resume his duties he took up the discussion, approving the position of the WESTERN ELECTRICIAN and the Chicago Electric club, and demanded a reconsideration of the plans. In a personal interview Chief Burnham admitted the justice of the demands of the electrical interests, and promised Chief Barrett that he would substitute a circular building designated "Machinery Annex," which would provide all the room required by the electrical people.

Owing to a statement published in a daily paper referring to this arrangement and attributed to Prof. Barrett, Chief Burnham declared he would adhere to his original plans. Interviews and correspondence between Chiefs Barrett and Burnham failed to secure an amicable settlement of the issue, and the discussion was finally closed by the construction department notifying Chief Barrett that it had nothing further to communicate. This rather abrupt discontinuance of negotiations left Chief Barrett with but one alternative—an appeal to Director General Davis and the board of directors. This he decided to do, and on the return of Col. Davis the matter will be brought to his attention. It is expected he will show more deference to the wishes of the electrical people than Chief Burnham has done, and through him they hope to secure consideration for their claims. It is safe to say that the present plans will not be approved by the board of directors. Mr. Burnham's action in abruptly terminating the discussion over the proposed buildings has made it necessary for the board of directors to consider this matter and, possibly, define the limits of his authority.

DESPITE the apparent success that has attended Mr. Ferranti's work the London *Electrical Review* continues skeptical. It says: "There are not wanting men who, quite impartial, have watched Mr. Ferranti's scheme from its inception, and who now more than ever believe that high tension will, before very long, resolve itself into a pressure not exceeding 2,000 volts, and we shall not feel the least surprise to learn that Deptford will shortly be working 5,000 volts as a maximum."

THE electrical interests will be ably represented this year in the World's Fair directory. Col. Clowry has been re-elected and the electrical people have gained another representative in the selection of B. E. Sunny. Both of these gentlemen will prove valuable supporters of Chief Barrett's department. Col. Clowry's experience last year as chairman of the electrical committee will prove valuable to him. Mr. Sunny has taken an active part in World's Fair matters and is well qualified for the position. There are many other friends of the electrical department in the new board, though they may not be directly connected with the electrical business.

THE WESTERN ELECTRICIAN is always glad to note signs of improvement and progress in its contemporaries and equally reluctant to draw attention to their failings, but whenever it becomes apparent that a reproof is necessary we do not shrink from the task, nor do we hesitate to give our contemporaries the benefit of our advice and experience. In a recent issue we had occasion to call attention to the "literary" column of the *American Engineer*. We were pleased to note our contemporary's ambition in this line, although it was apparent that it had a hard task before it. Yet we felt that it was within the range of possibilities to establish a "literary" column even in the *Engineer*, and we only wish we could reasonably hope to see the day when such a classification in the columns of our contemporary would not be necessary. Our hopes in this direction were rudely shaken, however, when in a later issue there appeared in a prominent position on the editorial page a trade circular of a Pittsburg concern. It must be admitted, however, that the circular would compare favorably with the other "editorials" in literary style. In the last issue a marked improvement in the selections for the "editorial" page was noticeable. One of these was from Webster's International Dictionary. The venerable editor of the *Engineer* is to be congratulated upon his advancement. When he has satisfied his curiosity, so far as the dictionary is concerned, we would advise him to take up the study of English grammar. It will prove both interesting and instructive.

AN interesting article on the relative cost of gas and electricity as illuminants has been prepared by John G. Boyd of St. Louis. Attention is called to the fact that while manufacturers, as a rule, are quick to admit the signal and manifold advantages of the electric light as an illuminant, they are equally prompt in despairing at the item of first cost, qualifying their action by further declaring that while they are free to acknowledge its claims of supremacy, yet the condition of their business will not, at present, justify the increased expense. In this instance the consumption of gas is taken at its extreme minimum, and electricity at its extreme maximum cost. Yet it is shown by careful calculation that in order to compete with electricity in cost alone we must be furnished with gas at the rate of 52 cents per thousand feet. It is scarcely necessary to say that no such price has yet been secured. In addition to this it is to be borne in mind that the cost of electric lighting is one of the least important considerations. Where health, cleanliness and superior illumination are considered there is no room for argument as to the desirability of electric lighting.

SO many sensational accounts of accidents from electric wires have appeared in the daily papers that there are, without doubt, many persons who still labor under an impression that electricity is, comparatively speaking, a dangerous agency. Whether this is so or not we will soon be able to judge, for, according to recent dispatches from Washington, a company is collecting statistics of accidental deaths in the principal cities of the country with the idea of showing the proportion of deaths from electric currents. The accidental death statistics have been compiled for Washington and the figures tend to prove the company's theory that the proportion of deaths from electricity is much smaller than is generally supposed by the people. From the figures furnished for Washington, covering five years, it appears that out of 299 fatal accidents, only one death was caused by an electric shock, while 22 persons were suffocated by gas. It might be mentioned also that the same statistics record 54 deaths from being "run over by the cars." These figures show that the advancement made in the application of electricity has been made in spite of popular prejudice, which of course was due largely to ignorance. It should be borne in mind that the majority of the deaths due to electricity may be attributed to the carelessness of the victims.

ONE of the most important questions before the construction department of the World's Columbian Exposition is that of transportation about the grounds. It was reported in the daily papers last week that the Adams system, recently illustrated in the WESTERN ELECTRICIAN, would be adopted. This is positively denied by Engineer Gottlieb, who says that no system has yet been recommended by that department. He says competition is still open for elevated systems of all kinds, whether operated by electricity or other means. Mr. Gottlieb evidently adheres to his original plan, not to consider surface roads. We do not believe it possible that the construction department would recommend a system of electric railways, practically unknown, when there are many systems that have proved commercially successful. Mr. Gottlieb says he does not know of any road, commercial or experimental, constructed according to the Adams system. It would be the height of absurdity to adopt a system without any practical demonstration of its ability to meet the requirements of the case. The projectors of the Adams system would not have time to develop their system and the opening of the fair would find it still in an experimental condition. Electrical engineers will vigorously oppose the adoption of any experimental system for the fair—the place to display such systems is on the experimental road.

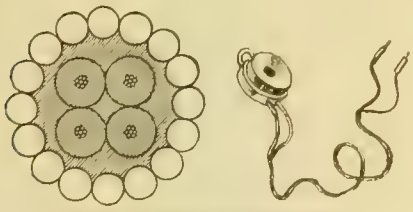
The Telephone Line from London to Paris.

The proposal to open communication by telephone between Paris and London came originally, it is said, from the French administration. The scheme involved, as a matter of course, the laying of a telephone cable across the Straits of Dover as well as the construction of land lines. It was decided to have two separate circuits, so

SUBSCRIBER'S SILENT BOX.

that if one should fail at any time the other might be brought into service. The route for the English land line, which was selected by Edward Graves, engineer-in-chief of the postoffice, runs along the Southeastern railway to a point near Sidcup and thence by road and rail through Swanley, Maidstone and Ashford to the cable house on the beach at St. Margaret's Bay, between Dover and Deal.

The building of the line was begun in September last and was completed by the first week in March. On the morning of Monday, March 9th, the French end was landed. It was half-past nine when the lifeboats were launched, and twelve minutes to eleven when the end was hauled ashore and the ship started paying out toward St. Margaret's Bay. Owing to bad weather it was not until the 14th that it was possible to land the English end of the cable. The Monarch, the cable ship, arrived at St. Margaret's Bay about twenty minutes past three in the afternoon, where she anchored 1,000 yards away from the landing place. A raft was formed with the lifeboats, and the shore end landed in the same way as at Sangatte. The end was hauled ashore by sailors at ten minutes past six, and twelve



SECTION OF CABLE AND TELEPHONE.

minutes later it was brought into the cable hut. The end of the cable was then stripped and the sheathing filed off. The cores were next pared and the cable connected to a Morse apparatus, by which the hut was put in telegraphic communication with Sangatte. An informal conversation was carried on by telephone, on Sunday evening, March 15th, but the messages only passed from the cable hut at St. Margaret's Bay, near Dover, to Paris. As had been arranged there was no formal conversation carried on over the line until the French engineers arrived in London.

M. Amiot, the inspector-general of French telegraphs, was the first person to speak formally over the line. Lieut. O'Meara, R. E., followed, and was the first Englishman to speak across the Channel. On the following Tuesday M. Amiot, who proceeded to London, thence addressed his colleagues in Paris. The Gower-Bell apparatus was that employed. Prof. Hughes, of microphone fame, Mr. Graves, Mr. Preece and others afterward spoke through the line. On Wednesday, March 18th, the establishment of telephonic communication between London and Paris was officially inaugurated. The first message transmitted was one from the Prince of Wales to M. Carnot, president of France. At the Paris central telegraph station Lord Lytton, Madame Roche, M. Reinach, M. Broquisse and M. de Selves were present with M. Roche.

At the postoffice the instruments were fixed against the wall on a board covered with red cloth, inscribed "Paris-London," and decorated with tricolor and union jack. The chief transmitters pitted against each other are the Gower-Bell, the Hunnings, the Berliner, the Ader, d'Arsonval and Roulez. So far, the postoffice form of the Gower-Bell apparatus appears to excel the others. The Ader seems to be the best of the French instruments for this work.

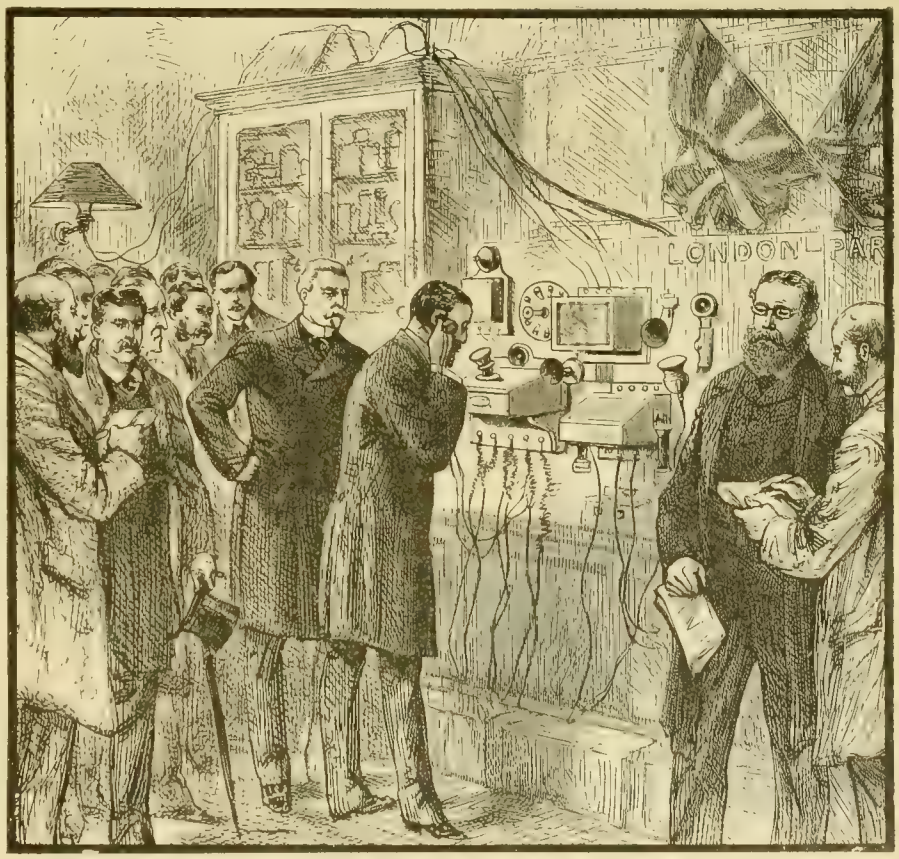
The cable for the line, as is now well known, was designed by W. H. Preece, electrician-in-chief of the London postoffice, and was manufactured by Siemens Bros., of Charlton. It contains four conductors, two for each circuit. Each conductor is a strand of seven copper wires, weighing 160 pounds per nautical mile, with a resistance of 7.478 to 7.632 ohms per knot at the testing temperature of seventy-five degrees Fahrenheit. Each strand is covered with three alternate layers of Chatterton's compound and gutta-percha weighing 300 pounds per knot. The total weight of each core is, therefore, 460 pounds to the knot. The insulating resistance from the wire to the water is not less than 500 megohms per knot after lying in water at a temperature of seventy-five degrees Fahrenheit for twenty-four hours before the test, and after the conductor had been electrified for a minute. The capacity does not exceed 0.3045 microfarads per knot. The cores are twisted spirally round each other in a strand, so as to change places like the land wires; and to silence the cross talk as much as possible, the opposite wires form part of the same circuit. The stranded cores are served with tanned hemp, and on this cushion is laid a spiral sheathing of 16 galvanized iron wires, each 0.28 inch thick, with a breaking stress of 3,500 pounds. Clark's coating of mineral pitch and sand protects the whole.

The English land line is of copper, and weighs 400 pounds to the mile. It has a resistance of about 2.25 ohms per mile at sixty degrees Fahrenheit and is supported on creosoted wooden poles, seventy yards apart, by means of double-shed porcelain insulators hung about twenty-five feet above the ground. The going and returning wires of each circuit are twisted spirally round each other all the way, exchanging places at each cross-arm, the spiral being completed by each wire regaining its normal position at

LANDING THE CABLE AT SANGATTE.

every fourth pole—that is to say, every 280 yards. The buzzing effect of induction has been reduced to a minimum. A Wheatstone automatic transmitter working at fast speed on one of the circuits can just be heard, it is stated, in the telephone upon the other circuit. The French land line is similar in construction to the English line, except that only one circuit is run at present, and the copper wire weighs about 600 pounds to the mile. Its length is about 204 miles, and the speaking with the D'Arsonval apparatus employed in France is also excellent. There are, unfortunately, no less than seven kilometres of underground line in Paris. This is constructed on the Fortin-Hermann system, and is insulated by wooden beads impregnated with paraffin.

The product of the capacity into the resistance of the entire line from London to Paris is estimated at 5,300.

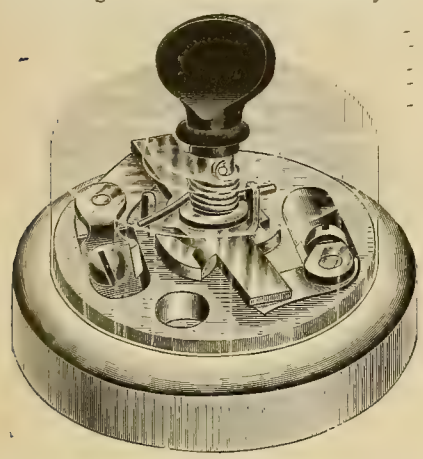


SPEAKING TO PARIS FROM LONDON.

The line was thrown open for public use upon April 2. The charge for three minutes' talk will be 10 francs or 8s. 4d. A tell-tale clock will keep record of the seconds, and when 180 beats have elapsed a bell will ring and the circuit will be cut off. Another 8s. 4d. will secure a second three minutes, but no more than six consecutive minutes will be allowed to any person. The cuts were taken from the *Illustrated London News*.

Sperry's Switch.

The accompanying cut shows a snap switch which was recently invented by Elmer A. Sperry, Chicago. The device is an ingenious one, and its special features will only be appreciated after an inspection of the switch itself. Referring to the illustration, it will be seen that the movable parts are only two in number, viz., the switch-bar and the handle-shaft. The switch-bar is slotted midway between the ends, so as to embrace the handle-shaft and at the same time slide freely across the face of a four-toothed ratchet-wheel attached to the porcelain base of the switch. Wound around and pinned to the handle-shaft, as shown, is a spiral spring which engages a lug on the switch-bar. A pin set into the handle-shaft extends horizontally to the right and bears against a second lug. A third lug on the bar rests normally in a



SPERRY'S SWITCH.

notch of the ratchet-wheel. The action of the switch will now be understood: Twisting the handle, or thumb-piece, to the right, throws the end of the spring against the lug and tends to swing around the switch-bar. Movement of the bar is prevented by the lug which is in the notch of the ratchet-wheel. The continuation of the twisting motion, however, brings the pin on the shaft into contact with its lug on the switch-bar, and the latter is slid along over the face of the ratchet-wheel until the lug is released from the notch. The spring is now free to act, and the bar jumps around a quarter turn. This switch is handled by the Sperry Electric Mining Machine company, Chicago.

Patents and Inventors.

The celebration at Washington last week commemorating the beginning of the second century of the patent system in this country was a most interesting event. The president of the United States opened the proceedings and made an address in which he said: "It cannot be doubted by any, I think, that the security of property in inventions is essential and highly promotive of the advances of our country in the arts and sciences. Nothing more stimulates effort than security in the result of effort."

Senator Platt of Connecticut in an address on "Invention and Advancement" said there were hundreds of men to-day who knew more of steam and electricity than was dreamed of by Watt or Morse, who were only prospectors. Of the seven wonders of the world, only one, the lighthouse of Pharos, was for human good. The seven wonders of the present age—the cotton gin, adaptation of steam to methods of transportation, appliances of electricity in business pursuits, harvesters, the modern printing press, the Biglow loom and the sewing machine—were all for the benefit of mankind. Such has been the effect of inventions that the term of human life has been lengthened, and we have more comfort and less want, more pleasure and less pain, more ease and less hardship, than any other people who now exist.

In discussing the relation of invention to labor, Carroll D. Wright, commissioner of labor, took the ground that labor is benefited greatly by the introduction of power machinery and what are called labor-saving inventions. This benefit comes through the expansion of labor, as shown by the increased consumption of all raw materials and the increase in the number of persons engaged in gainful occupations, such increase being largely out of proportion to the increase of population itself. The commissioner asserted that the statistics disprove the fact that labor is displaced, for the increase in population in the United States between 1870 and 1880 was 30 per cent., while the increase in the number of persons engaged in all kinds of employment was 39 per cent. The speaker pointed out also that very many modern inventions have created employment where none existed before. The whole department of electricity, electric lighting, telegraph operations and the telephone are examples of this. "Hundreds of thousands of people," said Mr. Wright, "are brought into employment through modern inventions where no one was ever employed prior to such inventions."

Judge Robert S. Taylor of Indiana delivered an address on "Epoch-making Inventions in America," in the course of which he said: "Since Franklin drew the first submissive spark from heaven Americans have been foremost in the great field of electricity. The subjugation of this great force was begun when Prof. Morse taught it to talk. The steam engine is the breath and muscles, the telegraph the nervous system of the body politic.

"In the production of the electric light," continued Judge Taylor, "man has come nearer to creation than anywhere else." He has produced upon earth the light of the heavens—a true sunlight in fragments, for, as Judge Taylor believes, "the sun and stars are lighted by electricity." The invention of the telephone was referred to. "No man," said the speaker, "can add a cubit to his stature, but Prof. Bell has added many miles to our tongues."

In the address of Prof. Thomas Gray, professor of dynamic engineering in Rose Polytechnic Institute, Terre Haute, Ind., the early rise and progress of telegraphic invention was briefly sketched, from the magnetic telegraph spoken of in fable through the various proposals to use frictional electricity for telegraphic purposes. Prof. Gray pointed out that the credit of inventing the telegraph cannot properly be given to any one man; that a great many men have added something toward its development, and that the subject grew by many contributions to its present huge proportions. In speaking of the early origin of the electro magnet telegraph he said that, although no doubt an American invention, the credit should be given to Prof. Henry, as he not only made the first application of the electro magnet to this purpose, but supplied by his researches the knowledge on which Morse's system was made to work. The problem of the transmission of speech and of musical sounds was described and the various attempts at a solution criticized. The importance and distinctive character of Bell's method was pointed out, and the difference between this method and that of Reis, which has received so much attention in all discussions as to priority of invention, was referred to. The various methods, particularly that of Dolbear, for attaining the same result, were noticed. The various devices which have since been invented as telephonic transmitters were described and their similarity in principle to the device proposed by Bell and Elisha Gray was commented on.

Prof. Cyrus F. Brackett's address on the "Effect of Invention upon the Progress of Electrical Science" was an excellent popular history of the development and application of electricity.

Receptions were held at which delegates and visitors were entertained. They also visited the patent office, and received every attention at the hands of the officials.

Government Telegraph Rates.

Jay Gould and the postmaster-general had a long conference on the occasion of the former's visit to Washington a week ago. The question of rates on government telegraph business from July 1, 1891, was discussed, as was also the question of increased mail facilities on the Union Pacific railroad. Telegraph tolls, however, was the principal theme of the talk. Next June two years will have elapsed since Mr. Wanamaker fixed the schedule of rates which the government should pay the Western Union for telegraph service. The Western Union refused to accept these rates, but continued to perform the service. The consequence is that the government has paid nothing for its use of the telegraph since that time, and the amount now due the company has reached large proportions. Mr. Gould talked the matter over with Mr. Wanamaker, but no definite conclusion was reached.

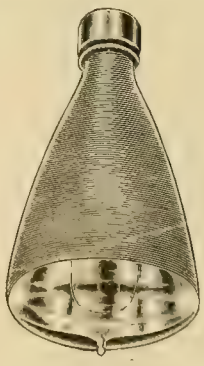
Lighting Bartholdi's Statue.

There is considerable dissatisfaction with the effect of the lighting arrangement of the Bartholdi statue. At present the statue on Bedloe's Island is not brought out with distinctness, the graceful lines of the figure are entirely lost and only the pedestal, which is illumined by a powerful light reflected up from the walls surrounding its base, can be distinguished clearly. The one light which gleams from the uplifted torch, the first light of the harbor seen by incoming ships, has not been satisfactory. Major D. P. Heap, Corps of Engineers, U. S. A., stationed at the lighthouse depot, Tompkinsville, Staten Island, has a plan for the more perfect illumination of the Bartholdi Statue of Liberty, which, if adopted by the Lighthouse Board, will make the colossal statue a more imposing object, viewed at night in New York's harbor. At present the light finds its way out only through a series of large round holes. The metal in which these holes are made will be cut to the width of two and a half feet, and in its place Major Heap proposes to place a thick plate-glass window. This window will encircle the "flame" and will be made on bronze frames. This will render visible all the rays of light coming from the lamps, instead of only a part struggling through a few comparatively small holes.

The light itself will be aided by a powerful optical apparatus, in effect like a lens, which will encircle the electric lamps and which will have the power of concentrating into a horizontal beam of light all the rays passing through the window. With the use of such apparatus Major Heap says half the candle-power now used in the torch will be sufficient to give a light much more powerful than that thrown at present. It will be an intense, steady glow.

New Incandescent Lamps for Desks.

In the accompanying illustration is shown a new form of incandescent lamp, specially devised for desks, that is placed on the market by the Central Electric company of Chicago. This lamp differs somewhat in shape from the ordinary incandescent lamp, its sides being almost



NEW INCANDESCENT LAMP.

straight, while the bottom or large end is as nearly flat as possible. The advantage claimed for this form of lamp is that the straight lines provide better reflecting surfaces and prevent as much as possible, uneven intensities of light upon the object. The inside of the butt and the outside of the globe are silvered, and the incandescent filament is actually surrounded on three sides by a mirror reflecting all of the light downward. While the lamp may be placed on a level, or a little above the level of the eye, no light strikes the eye directly from the lamp, as the silvering is covered and protected by an opaque substance. The lamp is made to fit any socket.

An electric railway ten miles long is to be constructed at Manaimo, B, C.

World's Fair Electrical Building.

The electrical fraternity is still awaiting decisive action on the part of the World's Fair authorities on the subject of the electrical building. The election of new directors and the organization of the new board has delayed the work somewhat, but it is hoped that it will be reached at the first meeting of the board. All efforts to secure a statement from the construction department have failed. Director General Davis had not returned, but it is expected he will be present at the next meeting of the board of directors. He will be asked to make a statement to the board, covering the controversy between the electrical and construction departments.

The subject of this communication will be the inadequacy of the arrangements for the electrical building and other objections to Chief Burnham's plans, to which attention was directed by the WESTERN ELECTRICIAN three weeks ago. The directors will be called upon to consider the following facts:

Immediately following our editorial announcement regarding the plans for the electrical building at the exposition, the Chicago Electric club filed a protest with Chief Barrett, who in turn notified Chief Burnham. At the time Prof. Barrett was ill, but on his recovery he took up the matter and pushed it vigorously. In a personal interview with Chief Burnham the wishes of the electrical interests were made known and Chief Burnham agreed to substitute the circular building, described as the machinery annex, for that originally intended for the electrical display. Owing to a statement attributed to Prof. Barrett, and published in a daily paper, regarding this conference, Chief Burnham withdrew his approval of the proposed change and announced his intention to adhere to his original plans. Chief Barrett endeavored to convince Chief Burnham of the injustice of this decision but to no purpose. After several interviews and considerable correspondence Chief Burnham closed the discussion by refusing to further consider the matter, thus cutting off communication between the electrical and construction departments. The effect of such action will be readily understood by all who have had experience in managing extensive enterprises.

Chief Barrett now finds himself compelled to appeal to the board of directors through Director General Davis and it is expected he will be accorded a hearing at the first possible opportunity. Mr. Burnham's high-handed policy has already hampered the work of the electrical department too much, and it is earnestly hoped that there will be no further delay.

Inquiry at the headquarters of the construction department last week elicited no new facts concerning the plans for the electrical department. Chief Burnham has returned from his eastern trip. It was learned that he had decided to stand by his original plans, and endeavor to force them upon the electrical department, despite the protests of prospective exhibitors.

The construction department looks upon the matter as being practically settled, and, so far as it is concerned, has dismissed all thoughts of reconsideration and alteration of plans. It is, therefore, only too plain that in the course advocated by the WESTERN ELECTRICIAN last week rests the only hope of the electrical fraternity. The necessity of immediate action is apparent. Although Chief Burnham has no information to impart to the electrical people, the daily papers last week contained several important announcements evidently emanating from the construction department. Upon the return of Mr. Burnham from his eastern trip, the *Herald* announced that "Contracts for at least three of the great buildings of the exposition will be called for within a month. The buildings that will be first erected are those of mines and mining, transportation and electricity and electrical appliances. Architect Beman's designs for the mines and mining building were completed some days ago, and a careful estimate shows that it can be built within the appropriation named. The same has been found to be true of the transportation building and also of the building for electricity, which Professor Barrett says will be much too small for his department." It further says, "All the architects think that ample space has been provided for exhibitors."

It is evident that the architects know as little of the requirements of the electrical department as Mr. Burnham himself, who frankly acknowledges that he knows nothing whatever about the development of electrical industries. To all arguments for additional space and protests against the present arrangements, the construction department replies, parrot-like, "The proposed building contains ten times the floor space allotted the electrical display at the Paris exposition." This seems to be the only knowledge they have of the Paris exposition, so far as the electrical department is concerned, and they have absolutely no information regarding other displays of an electrical character far more important than the Paris exhibit.

It seems hardly possible that the World's Fair authorities will measure the importance of the electrical department by the display made at the Paris exposition. Such a proposition would be preposterous. Although 200,000 square feet of space were occupied, the electrical interests were not represented fully at Paris, nor was there any claim that such was the case. On the contrary, the fraternity was heartily ashamed of the showing, although there were creditable individual exhibits. From present indications, if Mr. Burnham has his way about the matter, the electrical fraternity will have little reason to be proud of any display it can make, as it will be necessarily of secondary importance.

The election of B. E. Sunny as one of the members of the board of directors of the World's Fair was received with great satisfaction by the gentlemen representing the electrical interests in Chicago. Mr. Sunny is looked upon as a representative man, and as one who will take good care that the department of electricity is not slighted without at least an emphatic protest. He and Col. Clowry, who was formerly sole electrical representative on the board, may be depended upon to act wisely in the present crisis in the affairs of the department.

Mr. Sunny has not yet had time, of course, to enter fully into the details of his new position, but he is sanguine that the electrical interests will have fair treatment. "The matter of the building for the electrical display will surely come out all right," he said a day or two ago to a representative of the WESTERN ELECTRICIAN. "I am sure that the directors are friendly to the electrical interests, and that ultimately our request for more room will be heeded. The justice and equity of our claim are so apparent, that I cannot believe that the electrical display will be dwarfed for want of room. You may depend upon it that Col. Clowry, Prof. Barrett and myself will do all in our power to secure an adequate amount of space for the department, and, in view of the strength of our cause, I cannot doubt that we will be successful. I do not think that the published statement that bids will soon be invited by the construction department on the electricity building as at present designed, can be correct. I feel confident that there will be some radical changes before contractors are asked to figure on any electrical building."

In regard to the electric railways at Jackson Park, Mr. Sunny said that nothing had been done by the directors, and that the matter of intermural transit had gone no farther than Mr. Burnham's office. The new director intimated that he should have something to say on this subject, too, if, as reported, the chief of construction was in favor of an elevated system.

From the actual applications for space in the electrical building of the World's Fair now on file, Secretary Hornsby has ascertained that 86,000 square feet have already been demanded. This does not include informal requests from the Thomson-Houston company and the Western Electric company for 10,000 feet each. With these added, it will be seen that notifications have already been received for over 100,000 feet of space, or more than two-fifths of all the room available in Chief Burnham's proposed electrical building. And, this too, with the electrical department organized only two months and all the foreign, and by far the greater part of the American exhibitors yet to be heard from! Yet there are many people who wonder why the electrical interests cannot be satisfied with a building 350 by 700 feet.

In an account of Chief Barrett's efforts to bring the electrical display up to the high standard of excellence that he has set for it, the *Chicago Evening Post* says: "Unless the space for the department is cut down by the directory below what Prof. Barrett thinks he ought to have, inside of sixty days many large prospective exhibitors will have begun work on the more important of the articles they propose to exhibit. It is the intention of the large electric corporations to 'spread' themselves. Prof. Barrett is endeavoring to ascertain whether the exposition is to be open evenings. If it is, then the department will at once begin the now pending arrangements for some wonderful electric pyrotechnics. Unless Professor Barrett is handicapped by the provision of too little space and by the division of his exhibit the electrical department bids fair to be by far the most interesting and instructive of the exposition and to far and away eclipse anything of the kind ever attempted before."

It is becoming generally recognized that the only question concerning the success of the electrical exhibit is that of sufficient accommodation.

The widespread interest manifested in the controversy over the electrical building for the World's Fair should convince the directors at once of the desirability of granting the demands of the electrical department. Commenting upon the announcement recently made by the WESTERN ELECTRICIAN regarding the inadequacy of space furnished this department and other objectionable features of the plans under consideration, the *Electric Age* of New York says editorially:

If the reports that we hear about the provisions made for the electrical exhibition at the World's Fair are true, the situation is indeed disheartening, and the outlook anything but encouraging.

From all accounts it seems that ample space for the electrical department of the great exhibition has not been provided, and that, unless some better arrangements are made, the electrical exhibits will likely be scattered among several buildings.

This is an unfortunate state of affairs, and the electrical fraternity and press should use their united and strongest influence to secure for the electrical exhibit plenty of space and the recognition that its importance demands.

No other department at the exposition will be so important and so interesting. Electricity is holding the world spellbound to-day, and its marvelous development in recent years is the wonder of the age. People everywhere hear and talk about it, and expect to find at the World's Fair an exhibit commensurate with its importance

The possibility of the exhibit being scattered is sufficient cause for regret, and while the situation is an unfortunate one, no good will result by merely expressing regret that it is not more promising. It is no time for sentiment. Work is what is needed, and the sooner all hands interested take hold and "give a lift" the better it will be for the success of the electrical department. What is needed is an emphatic and able-bodied protest against the proposed plans as far as they apply to the electrical exhibit, and if the electrical trades would unite with this one object in view, we think that they will not labor in vain. It is a stupendous mistake for a person or a body of persons to assume that the electrical industry is of any but primary importance. It would be a great misfortune, and work irreparable injury to electrical industries, to scatter the exhibit and tuck it away in corners that no one else cares to use.

Prompt action is needed, and no doubt with the full power of the current of determination turned on, the energy, if properly applied, will accomplish the desired result.

A Boston syndicate has purchased the Trenton, N. J., city railway, and will doubtless avail itself of the recently granted permission of the city council allowing the road to be operated by electricity.

A cable train drawn by an electric motor is a sight that can be witnessed early in the morning or late at night every day at Omaha, Neb., says an exchange. The Omaha Cable Railway company had two lines, one turning off from Tenth street at Harney, and the other leaving Tenth street at Dodge. The Harney street line had the lighter traffic, the grades were not quite so even as on the Dodge street line, but it had more curves. Cables wore out rapidly, and it was decided last summer to abandon the Harney street line as a cable road and to equip it with electric motors. Overhead wires were put up and it has been operated as an electric line for the past six months. The cable power house and the car house for the grip cars and trailers is on Harney street, but there is no cable in the conduit leading from the power house to Tenth street. Hence, every morning the electric motor cars draw the cable trains from the car house to Tenth street, where they can get hold of the cable, and at night the electric cars bring the cable trains home from their work to the car house. Here is an instance where it has proved cheaper to operate a line by electricity than by cable, even after an expensive cable conduit has been built and operated.

Chicago Electric Club.

At the conclusion of Alex. Dow's paper on the "Regulation of Constant Current Generators," read before the Chicago Electric club April 6th, the following discussion took place:

F. L. PERRY: As no one seems prepared to start the discussion, I will relate what we might call a reminiscence. Mr. Dow in his paper has referred to quite a number of methods of regulation, but he has not mentioned one method of controlling an arc dynamo with which several, at least, of those present are familiar. I refer to the method of regulating constant current dynamos employed in the Weston machine which was exploited by the old United States company. In that machine, as I suppose will be remembered, there is a shunt field employed, and the machine is controlled by varying a resistance in that shunt field. The 25 light dynamo of this type has, I believe, an electromotive force of about 600 volts.

About three years ago I was sent out by the old Baxter Motor company to Moline, Ill, to start up two constant current motors, one of 10 horse and the other of 4 horse power capacity. These machines, it may be mentioned, had been installed by a salesman who had previously been an insurance solicitor, and consequently all the information I had to start with was that the dynamo to furnish current to the motors was a United States machine, and I was to run these two motors on it. I went down to Moline knowing only too well of the slow government of the U. S. dynamo. When I arrived on the ground I found that the motors were to run printing presses, that is, to run with varying loads, and I must confess I was a little nervous. I conferred with the electrician of the Moline company, Dr. Piper, and told him of my fears, and we both agreed that we would try an experiment if the machine did not carry the motors. Finally we started our dynamo with the slow moving regulator, and then went out into the town about a mile and started up our two machines. We first switched on the 4 horse power machine, got it under load and it ran very satisfactorily. We then went over to the other printing office, a few blocks away, and in the presence of quite a number of the residents of the town turned the current on the 10 horse power machine. I don't know whether Mr. Dow would have enjoyed the sight or not, but I think he would have sympathized with me at least. We didn't have any regulation whatever; the dynamo was evidently running away with itself. We did not run this machine very long, you may be sure, but prepared immediately to try our experiment. We decided that we would shorten the distance between the contacts on the resistance box, so as to alter the travel of the contact lever. We made a series of contact pieces out of strip metal, insulated them with thin strips of paper, and then massed them in a space of 1 9-16 inches on the box carrying the regulator. Insulated wires were next run from each contact on the regulator proper to the strips of brass on top of the box, and the arm of the regulator was lengthened so that it would play over the face of these strips. Then we had another trial and the regulation was much better. We found the current to be not exactly a pulsating current but a wavy current. That was encouraging. Our next attempt to improve the regulation was by increasing the speed of the regulator, and it occurred to us, following out the same line of thought as was just suggested by Mr. Dow, that an arc lamp in the circuit would help us out a little, from the fact that when the current commenced to fall the lamp would shorten its arc and thus tend to lessen the resistance of the circuit. We inserted one lamp in the line, and after having increased the speed went back and again started the 4 horse power machine, which ran very satisfactorily. We then went down to our 10 horse power machine and switched it on with a like result. To make the story short, I will conclude by saying that from what I can learn this modified regulator is still running in the Moline station.

MR. KEMPT: Is the motor running still?

MR. PERRY: I don't know the exact condition of things there now. Six months ago I had sent to me a photograph of the regulator taken while running.

W. L. BECKWITH: I wish to say in connection with Mr. Perry's remarks that the machine is running to-day. I saw it about a week ago, apparently running very well.

MR. DOW: I would say in regard to the regulation of the old United States machines, it is similar to the regulation by a rheostat, which I explained here, but it was applied in a shunt, in just the way that the regulation is applied in all the shunt wound incandescent dynamos, and it was very slow regulation. Then again the machine was essentially an incandescent machine, a very efficient dynamo, but a terribly poor machine for running arc lights. The reason it is so poor is that any disturbance in the circuit would cause a wave from its normal current of 30 or 33 amperes. I can understand the trouble Mr. Perry had, and the improvement that he made was, to put it in the shortest words possible, to increase the speed of regulation, but at the same time he did not increase the momentum of the regulator. The momentum of the regulator presents the greatest difficulty to be overcome. It will overrun the mark both ways. If you put on a dashpot it does not act quickly enough, and it does not take up the motors when they are thrown on, nor drop them when they are thrown off. If you do not put a dashpot on, the current will wave up and down. The regulator will act perfectly if you only switch the motor off and on slowly, but if you throw it on or off suddenly the motor will overshoot the mark every time. Mr. Perry did not in any way increase the momentum of the regulator, but he practically increased the speed of regulation.

THOS. G GRIER: I would like to ask Mr. Dow whether he can tell us anything about the third brush regulation of the Waterhouse machine?

MR. DOW: I never ran a Waterhouse machine, but I have watched them carefully. The old Waterhouse dynamo as a general rule is unsteady on small loads. The designer of the machine seems to have recognized that fact. The provision of a resistance board by which you are supposed to switch in so much idle resistance when your circuit is short, seems to indicate this. The third brush would probably work very well were it not for the fact that the attempt is made to combine it with an armature of high efficiency instead of an armature at low resistance but not of high efficiency.

MR. GRIER: I noticed in running Waterhouse machines that when only a few lamps were on it is necessary to put in considerable dead resistance, and that the machine regulated very nicely when you had a circuit of 12 to 15 miles, but when it was on a commercial circuit of about two miles there was considerable trouble, and an additional resistance board was used to keep the machine in regulation.

MR. PERRY: I want to correct an impression that may have arisen. I do not claim to have improved the United States machine. I merely made a fairly successful attempt to obtain a practical regulation as far as the speed of the motors was concerned. All that was wanted was to stop the complaints from the pressmen.

The Highest Economy in the use of Incandescent Lamps.

BY H. WARD LEONARD.

In operating incandescent lamps of any particular make, their average life will depend upon the incandescence at which they are operated.

The higher the incandescence of the carbon filament, the greater the amount of light which will be produced by the expenditure of a certain amount of energy, and the less the average life.

Lamps can be made by any manufacturer which shall have practically any desired average life, if the efficiency be not fixed.

As we decrease the power necessary, that is, increase the efficiency, we effect a saving in the first investment and in the cost of power required to operate the lamps, but simultaneously we decrease the average life of the lamps, and hence increase the cost in operating due to lamp renewals.

It will, therefore, be evident that whenever the cost of power and the cost of incandescent lamps for renewals is fixed, there will be a certain definite efficiency and corresponding life, which for any particular make of lamp will represent the condition of highest economy in the use of the lamps.

The consumer of incandescent lamps has his attention forcibly brought to the cost of the lamps he uses for renewals, but is usually unable to determine definitely the amount and value of the power required to operate the lamps. Consequently, he is frequently led to believe that the cheapest lamp for him to use is necessarily that which gives the longest life. Unless the power required is the same for the different lamps, this is not true, and frequently consumers are operating at very poor economy, and yet believe they are obtaining very good results, merely because their lamp breakage is small.

Let us examine this subject briefly.

The measurement of light is rated in "candle power," and the efficiency of production of the light is rated in "watts per candle."

The number of watts required by any lamp is the product of the volts and amperes used by the lamp.

Thus a 100 volt lamp using ½ an ampere absorbs 50 watts, and if the lamp be a 16 candle power lamp, the "watts per candle," which is the measure of its efficiency, would be $\frac{50}{16}$ = 3.1 watts per candle.

Similarly, a lamp of 24 candle power taking 110 volts and .676 amperes absorbs 75 watts, and has an efficiency as before, of $\frac{75}{24}$ = 3.1 watts per candle.

These two lamps, operated as indicated above, will have the same average life, because the incandescence of the carbon, and therefore the efficiency, is the same in the two instances. Let us suppose this average life to be 600 hours with the efficiency mentioned, namely, 3.1 watts per candle.

Now, suppose we take the lamp designed to be operated at 3.1 watts per candle, giving 24 candle power at 110 volts, and instead of subjecting it to 110 volts, reduce the pressure to 104 volts. The reduction of pressure will cause a reduction in the current through the lamp from .676 amperes to .623 amperes; consequently, the watts absorbed by the filament will be 104 x.623=65 watts. The candle power will be found to be 16 instead of 24 as formerly. The efficiency will be $\frac{65}{16}$ = 4 + watts per candle. The average life at this efficiency will be not less than 1,500 hours.

Yet it does not follow that the most economical results will be obtained by operating the lamps at such an efficiency and life, although at first such might be thought to be the case.

In order to investigate this question, it becomes necessary to determine the cost of power under different conditions. Perhaps the best authority on this subject is Charles E. Emery, Ph. D., who has thoroughly investigated and reported upon this question. The following values are taken from his report:

The cost of producing one horse power for 10 hours per day for 309 days in the year, by means of a first class engine using 27 pounds of feed water per indicated horse power per hour, is $52.15, where anthracite coal is $4.17 per ton, and where an engineer's wages are $2.00 per day. Of this $52.15, $24 06 is the cost of the coal, and $28.09 is that due to expenses outside of coal, such as wages, repairs, oil, waste, insurance, taxes, etc. That is, it costs $52.15 to produce 309x10 = 3,090 horse power hours, hence one horse power hour costs $\frac{52.15}{3,090}$ = 1.7 cents.

The cost of the power for operating a 16 candle power incandescent lamp will, of course, vary with the number operated per horse power. When the lamps have an efficiency of 3.1 watts per candle, twelve 16 candle power lamps are operated for each horse power in the driving belt of the dynamo.

In alternating systems as ordinarily installed, the variation of pressure is often too great to use the 3 1 watt lamp economically, and the 3.6 watt lamp should be used. Also in cases when the cost of power is extremely low, the 3.6 watt lamp should be used. It will not be found economical to operate the best makes of lamps at more than 3.6 watts per candle under any conditions met with in practice.

The majority of 16 candle power incandescent lamps on the market to-day require from 57 to 65 watts; that is, to have an efficiency of from 3.6 to 4 watts, and attention is called to the fact that in order to compare in quality with a lamp of 50 watts with a guaranteed average life of 600 hours, there should be a guarantee of 900 hours average life for the 57 watt lamps, and of 1,500 hours' average life for the 65 watt lamps, and that even then the consumer will not be operating at the highest economy as shown above. Furthermore, it must be borne in mind that by the use of 3.1 watt lamps, the capacity of a plant already using 3.6 watt lamps, will be increased 16 per cent., and in the case of a plant using 4 watt lamps, the capacity will be increased 30 per cent.

To express this another way, it may be said that a consumer having a plant using lamps of 3.1 watts, and changing to lamps of 4 watts, not only suffers the disadvantage due to the fact that he is not operating at the highest economy, but he also immediately increases his investment, interest, depreciation, etc., per unit of light obtained, to the extent of 30 per cent. and subjects his dynamo to an overload of 30 per cent. with consequent greatly increased trouble and expense due entirely to the use of the low economy lamps, but frequently attributed to a defect in the dynamo, as it is there that the overload manifests itself.

When the lamps have an efficiency of 3 6 watts per candle, 10-16 candle power lamps are operated per horse power; with lamps of 4 watts per candle, 9-16 candle power lamps are similarly operated per horse power, and with 2.77 watts per candle 13.4 16 candle power lamps. Consequently the cost of the power will be as follows for operating 1 16 candle power lamp for one hour:

	For lamps of 2.77 watts per candle, *i. e.*, 13.4 lamps to h. p.	For lamps of 3.1 watts per candle, *i. e.*, 12 to h. p.	For lamps of 3.6 watts per candle, *i. e.*, 10 to h. p.	For lamps of 4 watts per candle, *i. e.*, 9 to h. p.
Cost of power per 16 c. p. lamp hour, with power at 1.7 cents per horse power hour	0.129 ct	0.14 ct.	0.17 ct.	0. 9 ct.

If the average life of the lamps of 3 1 watts be 600 hours, that of the 3.6 watts lamp will be about 900 hours, that of the 4 watts lamp 1,500 hours, and that of the 2.77 watts lamp 300 hours.

Let us assume that the initial cost of a 16 candle power lamp is 44 cents, then the cost of renewals per lamp hour would be:

	For lamps of 2.77 watts per candle, *i. e.*, 13.4 16 c. p. lamps to h. p and 300 hours average life.	For lamps of 3 1 watts per candle, *i. e.*, 12 to h. p. and 600 hour life.	For lamps of 3.6 watts per candle, *i. e.*, 10 to h. p. and 900 hour life.	For lamps of 4 watts per candle, *i. e.*, 9 to h. p and 1,500 hour life.
Cost of lamp renewals per 16 c. p. lamp hour, with lamps at 44 cents each.....	0.146 ct.	0.073 ct.	0.049 ct.	0 029 ct.

Hence, the combined cost of both power and lamp renewals would be as follows:

	For 16 c. p. lamps of 2.77 watts per candle and 300 hours average life.	For 16 c. p. lamps of 3.1 watts per candle and 600 hours average life.	For 16 c. p. lamps of 3.6 watts per candle and 900 hours average life.	For 16 c. p. lamps of 4 watts per candle and 1,500 hours average life.
Power.....	.129 ct.	.140 ct.	.170 ct.	.190 ct.
Lamp renewals ..	.146 ct.	.073 ct.	.049 ct.	.029 ct.
Total cost per 16 c. p lamp hour when power costs 1.7 cents per horse power hour and incandescent lamps cost 44 cents each.....	0.275 ct.	0.213 ct.	0.219 ct.	0.219 ct.

Thus, under the conditions given, the most economical lamps to use will be those of 3.1 watts per candle, and 600 hours average life.

Now, let us suppose that the cost of power varies, as it will in different locations and under different conditions. It will be noted that of the $52.15 per year for the production of one horse power, $28.09, or 54 per cent., is independent of the cost of fuel. Let us suppose that the cost of fuel is nothing, and that the only expenses in the production of power are those due to labor, repairs, insurance, taxes, etc.

	For 16 c. p. lamps of 2.77 watts per candle and 300 hours average life.	For 16 c. p. lamps of 3.1 watts per candle and 600 hours average life.	For 16 c. p. lamps of 3.6 watts per candle and 900 hours average life.	For 16 c. p. lamps of 4 watts per candle and 1,500 hours average life.
Power	0.0684c.	0.0742c.	0.0901c.	0.1007c.
Lamp renewals	0.1460c.	0.0730c.	0.0490c.	0.0290c.
Total cost per 16 c. p. lamp hour when fuel costs nothing and incandescent lamps cost 44 cents each	0.2144 ct.	0.1472 ct.	0.1391 ct.	0.1297 ct.

It will be seen that the four watt lamp of 1 500 hours' average life becomes the most economical to operate under such conditions.

Now, suppose the price of anthracite coal, or its equivalent, to be $2 per ton. We then have the following relations:

	For 16 c. p. lamps of 2.77 watts per candle and 300 hours average life.	For 16 c. p. lamps of 3.1 watts per candle and 600 hours average life.	For 16 c. p. lamps of 3.6 watts per candle and 900 hours average life.	For 16 c. p. lamps of 4 watts per candle and 1,500 hours average life.
Power	0.0901c.	0.108ct	0.129ct.	0.14[illegible]ct.
Lamp renewals	0.1[illegible]0ct.	0.073ct	0.049ct.	0.029ct.
Total cost per 16 c. p. lamp hour where anthracite coal or its equivalent, costs $2 per ton, and 16 c. p. lamps cost 44 cents each	0.245 ct.	0.181 ct.	0.178 ct.	0.175 ct.

From the above figures it will be seen that the 4 watt lamp is the cheapest to operate under the conditions given, but the advantage is so trifling that in practice the 3.1 watt lamp would be the best to use, since the lamps fall off in candle power somewhat in long use, and with lamps having an average life of 600 hours, the average condition of the total number of lamps on a plant would be that due to 300 hours of burning, whereas the average condition of lamps having an average life of 1,500 hours would be that due to 750 hours' use, and it is evident that it will be preferable to have lamps which have averaged 300 hours of use, rather than lamps which have averaged 750 hours of use.

It will be seen in the figures given that the life alone is a poor measure of the economy of the incandescent lamp, and that in order that a 4 watt lamp should equal in quality a 3 1 watt lamp, its life should be 2 1-2 times as long, and that its average candle power in burning its 1,500 hours should equal the average candle power of the 3.1 watts lamp in burning its 600 hours.

In all instances quoted thus far we have assumed a cost of power based upon its production for ten hours per day under extremely favorable conditions. In the case of incandescent lighting plants, the load changes widely, and the maximum load is on for only two or three hours. The production of power is much more expensive under such conditions than when the load is constant. Statistics from a very large number of central station incandescent lighting plants, charging an average rate of 1 cent per 16 candle lamp hour, show that the total cost of power for operating a sixteen candle power 3.1 watt lamp is 0.4 cents per hour. The relative economy in the use of lamps of different efficiencies under average conditions of central station practice is, therefore, shown by the following table:

	For 16 c. p. lamps of 2.77 watts per candle and 300 hours average life.	For 16 c. p. lamps of 3.1 watts per candle and 600 hours average life.	For 16 c. p. lamps of 3.6 watts per candle and 900 hours average life.	For 16 c. p. lamps of 4 watts per candle and 1,500 hours average life.
Power	0.3[illegible]7 ct.	0.3[illegible]ct	0.464 ct.	0.516 ct.
Lamp Renewals	0.146 ct.	0.073 ct.	0.049 ct.	0.029 ct.
Total cost per 16 candle lamp hour when the power to run a 16 c. p. 3.1 watt lamp costs 0.4 ct per hour, and lamps cost 44 cts. each	0.5[illegible] ct.	0.47[illegible] ct	0.513 ct.	0.54[illegible] ct.

It will be noticed that the operating expenses are 8 per cent. less in the case of a plant using 3.1 watt 600 hour lamps than in the case of a plant using 3 6 watt 900 hour lamps. This is equivalent to an increase in the net profits of 12 per cent. in the case of an incandescent electric lighting company whose expenses are 60 per cent. of the total receipts, which is an average relation between the expenses and receipts in properly operated stations.

Attention is called to the fact that if the life of the incandescent lamp be increased, or the price of the lamp be reduced, the importance of using the high efficiency lamp rather than the low efficiency lamp becomes even more marked than in the present instance.

Thus, if the average life of a sixteen candle power lamp of 3.1 watts be 1,200 hours, and the cost of the lamp be 40 cents, it will be found that higher economy will result by operating the lamp at 2.77 watts per candle which will reduce the life to 600 hours. This is shown by the following table.

	For 16 c. p. lamp of 2.77 watts per candle and 600 hours average life.	For 16 c. p. lamp of 3.1 watts per candle and 1,200 hours life.
Power	0.357 ct.	0.400 ct.
Lamp Renewals	0.066 ct.	0.033 ct.
Total cost per 16 c. p. lamp hour when power for 3.1 watt lamp costs 0.4 cents per hour, and lamps costs 40 cents each	0.423 ct.	0.433 ct.

In all systems having a fairly good regulation and distribution of pressure, and where coal costs from $2 upward for the equivalent of one ton of anthracite coal, the 3.1 watt lamp is the most economical.

The Use of Oil in Converters.

To the Editor of the WESTERN ELECTRICIAN:

I notice on page 192 of your issue of April 4th that you make comments on the use of oil in converters in connection with an account of the high pressure experiments of C. L. Brown, given on the next succeeding page. It may be interesting to you to know that the use of oil in converters was the subject of a patent applied for by me on May 9, 1887, or about four years ago, the number of the United States patent being 428,648.

There is a striking similarity between the figures of the patent referred to and the figures 6, 7 and 8 which you reproduce in relation to Mr. Brown's experiments. I have used converters or transformers immersed in oil for some time, and some of the commercial work of the Thomson-Houston company has been done in that way under my patent. I quote from the patent as follows:

"The convective fluid for small coils may be air only; but I much prefer to use oil, preferably mineral oil of a non-volatile character, which is also an excellent insulator. Oils of the paraffine series are suitable, especially those of high boiling point. Paraffine wax may itself be used as the filling, as upon slight heating it melts and becomes fluid, acting thereafter as an oil."

"A mixture of paraffine wax and mineral oil is good, for when cold is buttery or semi-solid, but when warm be comes perfectly fluid and convective, while during the warming much heat is rendered latent by melting the paraffine present."

"The immersion of the induction coil in such an oil gives great advantages in keeping out all moisture, in avoiding the necessity for other insulation on the copper wire of the coil than the cotton or other porous covering which becomes permeated by the oil, and in transferring heat by convection from the body of the induction coil to the external iron casing, by which latter it is, on account of the large surface exposed to the air, dissipated. Besides these advantages the casing may be so covered or slotted that it can be exposed to the weather without risking the insulation of the coils. Ventilated coil casings in foggy or very rainy weather so exposed may easily become leaky and cause, through access of moisture to them along with the entering air, a loss of insulation of the inclosed coil."

"The casing which I use is of course closed or made tight, or is suitably constructed to prevent escape of fluid or access of water. When the coil is placed in it the whole is heated to the boiling point of water, or a little above, to drive out all moisture from the casing and inclosed coil, and cause the oil to thoroughly permeate the spaces."

Yours truly,

ELIHU THOMSON.

LYNN, MASS., April 7, 1891.

The annual meeting of the stockholders of the Thomson-Houston company was held at Middletown, Conn., on April 13th, and the following named directors elected: Henry A. Pevera, Charles A. Coffin, Joseph N. Smith, Benjamin F. Spinney, Charles B. Newhall, T. J. Jefferson Coleridge, S. Endicott Peabody, E. Thomson and Frederick P. Fish. Mr. Fish is a new director and Prof. Thomson reenters the board. The annual statement of the year ended Feb. 1, 1891, shows that the company's sales have increased from $426,987 in 1883 to $10,617,601 in 1890. More than 1,000 companies in the United States are using the Thomson-Houston system; 500 of the arc-lighting companies operate an incandescent system, employing between 600,000 and 700,000 Thomson-Houston lights; and the company has more than 150 lines of electric railways under contract and in operation, aggregating over 2,000 cars. The surplus Jan. 1, 1891, was $6,022,533.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 11.—This week the New York Central railroad has been making a test of lighting its Fourth avenue tunnel by electricity. The west side tunnel through which the northern bound trains run was made brilliant with incandescent electric lights of 50 candle power each. The lamps were so arranged as to direct the rays of light ahead, thus avoiding the direct glare into the engineers' eyes. The lamps were placed 140 feet apart on either side of the tunnel in an alternate fashion, arranged on supports about four feet above the ground. President Depew and Vice president Webb took a party of newspaper men in an observation engine to see the working of the lighting. It was observed that from a long distance the danger and cautionary signals were easily distinguished. As soon as that part of the tunnel which is lighted by electricity was reached, the lights of the danger signals were lost in the dazzle and flood of electric light. Engineers do not like the change, and it is probable that electric lights will not be adopted.

The telephone service of the city is again attacked by Mayor Grant. His idea is that the city should have its own telephone service. Recently he said: "At present we are at the mercy of the Metropolitan Telephone company, one of the many companies which the city has been fighting from time to time on account of its overhead wires." He further says: "As the city does not have to pay for its use of the subways all the expense would be in the plant. The saving to the city would be considerable. Why, the department of charities and correction alone pays this company $7,000 per year for telephone service."

The Rapid Transit Commission held a meeting last Monday to which no outsiders were admitted. The discussion which engaged its attention was the proposed routes through the city. President Steinway is reported as saying:

"Some of the people who have suggested plans and routes claim to have pre-empted the latter. If they have done so in the meaning of the law, of course we cannot use those routes. Our idea is to make a route that has as few curves at possible. Curves are an enemy to real rapid transit, and the nearer to a straight line we can make the route the faster time can be averaged. Our engineer will lay out a route in accordance with the agreement we arrived at to day, and as soon as his map is completed the commissioners will go over the route personally and determine for themselves its advantages and disadvantages. The individuals and corporations that have submitted routes to us have generally taken into account the cost of rights of way and gone out of the way in some instances to reduce the prospective expense. Rights of way will not bother us. We will consider only where the route can be located so as to prove of the greatest benefit to the city generally. When that question is disposed of we will take up the subject of style. We will determine whether to authorize underground or elevated lines, or we may decide to have both. These two important points settled, the balance can be easily disposed of. You can say that our work is rapidly approaching completion, and we are pushing it as fast as is consistent with a due consideration of so important an undertaking."

The subway bill has passed the Assembly and it is said that there was no opposition to the measure from local authorities. Rival stock interests seem to be at the bottom of the contest over the bill. The object of the bill is to confirm the contracts made by the Consolidated Telegraph & Subway company with the Empire City Subway company to divide and separate the work of constructing high and low tension subways.

A syndicate of Boston and New York capitalists have purchased the railroad and rolling stock of the Trenton City Railroad company. Seven hundred shares of stock were transferred, and the balance of the stock, 198 shares, is to be delivered May 1. The basis of the purchase was at the rate of $125 per share. The old company never paid a dividend and had been in existence about fifteen years. Its floating debt is about $40,000. The same syndicate is endeavoring to secure control of the Trenton Horse Railway company with a view of consolidating both roads and installing an electric motor system Col. Lewis Perrine, who is the controlling owner, declines to say whether such a consolidation will take place.

The electric cars, which have run on the Fourth avenue line for a year or more, have been withdrawn and there is no prospect of the immediate use of these or any other storage battery cars in this city. The experiment was abandoned on account of the legal and financial snarls in which the operating company became involved. Patent litigation was the chief difficulty encountered by the owners

of the Julien storage battery, which was the system used. The Accumulator company first sued the Julien company and obtained an injunction for infringement. Then the Brush company brought successful suit. The Julien company thereupon leased the patents of the Brush company, and the latter corporation has in turn brought suit against the Accumulator company for infringement. The last suit will soon be decided. The immediate cause of the withdrawal of the cars it is explained was the exhaustion of the financial resources of the operating company.

W. H. T.

Pittsburg, Pa.

PITTSBURG, April 11.—A new telephone keyboard containing fifty keys has just been added to the electrical outfit of the municipal electrical department of this city.

The Second Avenue Electric Street Car company of this city is now increasing the capacity of its road by putting several new vestibule cars on the line. All these new cars will be equipped with the Westinghouse slow speed armature single reduction motor.

The Johnson Street Rail company near Johnstown, Pa., is now introducing electric welding machinery to make rails whose length will be limited only by the facilities of transportation.

The largest electric welding machines that have ever been constructed in this or any other country are now in progress of manufacture for the company, and the plans already under way contemplate the investment this year of nearly a quarter of a million dollars. Before adopting the process the company experimented with it for over a year, and with such a success that it has unhesitatingly adopted it and found new fields for its use as adapted to its particular business.

Each welding machine has been adapted and designed to the particular work it has to do, and the adaptation of electric welding to the Johnson company's use has been novel in many ways. The company has now under process of construction one welding machine that will weigh from twenty to twenty-five tons, measuring fourteen feet one way by about eight feet the other. By the means of this machine longer rails will be made which will involve fewer splices, with fewer bolts and nuts to get out of order.

E. H. H.

Kansas City, Mo.

KANSAS CITY, Mo., April 11.—About two months ago protectors against damage caused by thunderstorms and fires, were put on the lines of the Missouri & Kansas Telephone company in this city. The storm of the past week subjected the device to an extended test, which it withstood successfully. There were evidences that some of the strong currents of the storm had been conducted along the wires but the arrester had performed its duty well, and no damage resulted. The device used is composed of two plates of carbon separated by a sheet of mica. One of these carbon plates is connected with the earth and one with the line to be protected. There are about 2,600 of these protectors in Kansas City.

The Western Storage Battery Manufacturing company is a new organization which intends to erect a plant here for the manufacture of storage batteries. The parent company which controls the battery is located in Lowell, Mass. It will be asked to have all the work done by the new plant in this city.

Thomas O. Combs has taken out a permit to erect the power house of the West Side electric street railway at Third and Oakland avenue, Kansas City, Kan. The building is to be 25x150 feet in dimensions, two stories high and will be built of brick. It will cost $7,000. The dynamos, engines and store room for the cars will be in this building. Work has already begun on the building. The work on the road proper is also being pushed rapidly. Contractor Lambkin thinks that there is no doubt that the work will be completed by May, according to contract.

Chief Speers was this week discussing with Alderman Hunter the advisability of putting in an electric police alarm system. He strongly urges the advisability of some plan that will be better than the telephone system now in use, and he thinks it could be put in operation at a cost inconsiderable in itself when the benefits are taken into consideration. He recommends that if the city cannot put in an alarm of its own, a contract be entered into with some electric company, the city to have the privilege of purchasing at any time. The estimate for 100 electric signal boxes is $20,000 if purchased, or a rental of perhaps $3,000 per annum.

At the last meeting of the council, Councilman Hayes introduced a concurrent resolution reciting that the city is paying electric light companies $200 and private consumers are paying $250 per annum for all night electric lights of 2,000 candle power each, and one cent per hour for sixteen candle power incandescent electric lights. It is believed from the poor quality of light furnished that the arc lights are far below 2,000 candle power and the incandescent lights below 16 candle power. In view of these facts he offered a resolution providing that a committee of two be appointed from each house to employ a competent electrical engineer to make a thorough test of the candle power of arc and incandescent lights, furnished the city and its citizens, and to report to the common council within thirty days, the members of said committee to be present at all tests made, together with the representative of each electric light company doing business in this city. The resolution was adopted.

P.

Minneapolis, Minn.

MINNEAPOLIS, April 11.—The frost is now rapidly leaving the ground, and within a few days the Twin City street railway corporations will resume the extension of their electric lines. The work, as it was left at the close of the mild season in 1890, was about two-thirds completed, but during the winter preparations have been so far advanced that it will require but a month or two to finish the great electric system in Minneapolis and St. Paul, as it was originally planned. All of the St. Paul lines are now operated by electricity, but at present the system in that city is by no means complete. Several new lines are designed for immediate completion, and there will be some important extensions on the old lines. In Minneapolis the work is by no means so far advanced. The West side lines, with the exception of those running on Bloomington avenue, Sixth avenue north, and Cedar avenue, are fully completed and in operation, but all of the East side lines still disport the ancient horse-car. Recently the ties for the wide-gauge electric tracks on the University avenue line have been distributed and this line will be the first one to be built. It was the intention of the company to build the Hennepin boulevard line first, but changes which the city contemplates making on the boulevard have rendered it necessary to postpone street railway work in that direction for the present. The injunction suit brought against the company by John Gluck and others to prevent the construction of the boulevard line was decided in favor of the company, and the death of Mr. Gluck, which occurred last week, probably ends all litigation over the matter. This line, with the others still incomplete, will be built as soon as the company can undertake the work, after which the attention of the company will be devoted to the construction of several suburban lines.

Plans are now being prepared for a large car repair and construction shop for the Minneapolis company. A site has been selected on Central avenue between Sixth and Seventh streets southeast, and the buildings will cover an entire block. Beyond this no announcement is made.

The Brush Electric company will shortly begin the erection of a new engine and dynamo room which will be quite an extensive addition to the plant. The company reports a very rapid growth in business, and expects this season to largely extend its service.

N. O. F.

Milwaukee, Wis.

MILWAUKEE, April 11.—Judge Gilson of the Superior court has refused the petition of Francis E. Hinkley of Chicago for the appointment of a receiver for the Milwaukee Electric railway. The injuction restraining the company from holding its annual meeting was dissolved. The court held that the question whether Pfister had any right to dispose of the stock pledged to him before all the bonds had been sold, was immaterial in the present case. The company will hold its annual meeting in a few days. Hinkley, it is quite probable, will be ousted from the presidency.

The common council has finally passed the ordinance compelling the Milwaukee Street Railway company to use the center pole system in equipping its lines with electricity.

The Milwaukee & Waumatosa Rapid Transit Railway company has been authorized to build and operate an electric road along Walnut street, Western avenue and other streets in the northwestern part of the city. The new line will connect the road with the down-town lines. The center pole system will be used.

Julius Meyer of New York, the engineer of the Edison General Electric company, who will have charge of the work of transforming the Milwaukee Street Railway company's lines into an electric system, has arrived. The engines which are to furnish the power for the new system will have a capacity of 7,000 horse power. Work will be carried on simultaneously on all the lines, and the extensions, including that to the Soldiers' Home, will be built at the same time. The center poles will also be used for electric light purposes.

About May 1st the formal consolidation of the Badger and Edison Electric Light companies will take place. E. C. Wall will be at the head of the Edison electric light business here.

C.

Cincinnati, O.

CINCINNATI, April 11.—The Colerain Avenue Electric Railway company—Thomson-Houston double trolley system—will at once install additional machinery, consisting of one 500 horse power Frick Corliss engine, two 300 horse power Heine safety boilers, fitted with Murphy furnaces, and four 100 horse-power 500 volt Thomson-Houston generators, which will make it the largest and most complete station of its kind in this part of the country.

The projected electric road from this city across the Ohio river and through Newport and the Highlands to Fort Crook is now a certainty. The capital has all been subscribed and B. R. Morton is making the survey. A party of stockholders went to Pullman, Ill., some days ago to examine an electric car made there which will accommodate ninety passengers. The system which is to be used has not been decided upon as yet, nor have any of the contracts been let. A considerable delay has been caused by the high water which has prevented the completion of the new bridge over which this line is to run.

G.

Sioux City, Ia.

SIOUX CITY, Ia., April 11.—F. T. Evans has recently put in a 600 light Brush alternating dynamo at Hot Springs, S. D. Beside furnishing light for the celebrated bathing houses this will supply the Minnekahta, Hot Springs and Gillespie houses. The dynamo will be driven by water power.

A. H. Zenner of the Electrical Supply company, Chicago, and F. T. Crane of the Electrical Engineering & Supply company, St. Paul, were in town this week.

Actions have been begun against the Iowa Union Telephone company. The plaintiffs claim damage for poor service. These will be somewhat interesting cases, for if the plaintiffs win several others will only have to make application for damages. The opinion of our city attorney is that this company really has no franchise, and that the council could order the present system removed. The telephone people have come to stay, however, and it is highly improbable that the council would resort to any such means.

A local telephone company with T. L. Foley at its head is trying to secure a franchise.

Gould's American District Telegraph company has just added the Holmes burglar alarm to its system.

The Postal & Western Union Telegraph companies are having their city lines reconstructed.

The Novelty Manufacturing company has moved into new quarters and has purchased a five horse power C. & C. motor to operate its machinery.

The Toy block, now near completion, will have a 500 light isolated plant.

T.

PERSONAL.

A. L. Rohner, the electrical engineer of the Lynn factory of the Thomson-Houston Electric company, passed through Chicago on his wedding trip last week.

D. H. Bates, vice-president and general manager of the Accumulator company, New York, and the Electro Dynamic company, Philadelphia, has resigned to take the general selling agency for the Edco street car system, with headquarters in New York.

NEW INCORPORATIONS.

Riverside Electric Street Railway company, Riverside, O.; to operate an electric railway.

Charleston Thomson-Houston Electric company, Charleston, Ill.; capital stock, $40,000.

People's Electric company, Cleveland, O.; capital stock, $10,000; to manufacture and sell electric power.

Denver Highlands Electric company, Highlands, Colo.; to furnish electricity for light, heat and power.

Wytheville Street Railway company, Wytheville, Va.; capital stock, $100,000; to operate an electric railway.

Lincoln Electric Street Railway company, Lincoln, Ill.; capital stock, $65,000; to operate an electric railway.

Central Avenue Railroad company, San Francisco, Cal.; capital stock, $1 000,000; to operate an electric railway.

Adams Milling & Manufacturing company; capital stock, $80,000; to supply electricity for lighting purposes.

Incandescent Light & Power company, Norwalk, O.; capital stock, $25,000; to supply electric light and power.

Ottawa Electric Street Railway company, Ottawa, Can.; capital stock, $500,000; to operate an electric railway system.

Eastern District Electric Light and Power company, Brooklyn; capital stock, $300,000; to supply electric light and power.

H. A. Doty Light and Power company, Janesville, Wis.; capital stock, $30,000; to manufacture and supply electric light and power.

Collingswood Water and Light company, Collingswood, N. J.; capital stock, $25,000; to supply water, electric light and power.

West Point Iron Works, West Point, Ga.; capital stock, $50,000; to establish iron works, electric light plants, waterworks, etc.

South Denver Electric Light and Power company, South Denver, Colo.; capital stock, $100,000; to supply electric light and power.

Union Electric Works, Chicago, Ill.; capital stock, $50,000; to manufacture and deal in all kinds of electrical devices and appliances.

La Grande Water and Light company, La Grande, Ore.; capital stock, $100 000; to construct and operate electric systems for supplying light and power.

Max Meadows Water and Light company, Max Meadows, Va.; capital stock, $100,000; to manufacture and sell electricity for all uses to which it may be applicable

ELECTRIC LIGHTING.

It is intended to light the streets of Madoc, Ont., by electricity.

The people of Merrickville, Ont, are clamoring for electric lights.

Rochester, N. Y, has 1,292 arc and 790 incandescent street lamps

McMinnville, Tenn., will soon vote on the question of electric lighting.

The city of Brenham, Tex., is considering the erection of an electric light plant.

Contracts have been let for the erection of an electric light station at Madison, Ga.

The Huntsville, Ala., Electric company will add a new incandescent outfit to its plant.

Efforts are being made for the establishment of an electric light plant at Kingston, Tenn.

Uniontown, Ala., has issued bonds to the amount of $25 000 for an electric light plant and waterworks

The erection of an electric light plant to cost $15,000 is contemplated by the authorities of Newberry, S. C.

The Syracuse, N. Y., Electric Light & Power company has secured a five years' contract to supply 500 lights in that city.

The Key West, Fla., Gas & Electric Light company will increase its capital stock $50,000, and put in a $40,000 electric light plant.

The Capital Electric Light, Motor & Gas company of Boise City, Idaho, will increase its capital stock from $20,000 to $50,000.

The Edison Electric Illuminating company of New York has declared the twenty-fourth quarterly dividend of 1 per cent., payable May 18th.

The directors of the Crystal Palace, London, have decided to organize a second electric light exhibition, which will be opened in the autumn.

The Bridgeport, Ala., Electric Light and Ice company has been organized to erect an electric light plant and ice factory. The capital stock is $60,000

Of 3,389 vessels that passed through the Suez Canal last year 2,836 used the electric light. By this means the average time of passage is shortened two hours.

The Dallas Construction company of Dallas has received a contract to erect at Ennis, Tex., an electric light plant This company has also purchased the city electric light plant at Terrell, Tex.

The Department of Public Works at Budapest, Austro Hungary, has submitted to the town council a plan for the electric lighting of the city. The city has announced its wish to receive plans in open competition for this project.

The Gooch Electric Light company of Louisville, Ky., recently incorporated, has amended its charter, changing its name to the Citizens' Electric Light and Power company, and increased its capital stock from $100,000 to $300,000.

The electric lighting of the imperial palace at Vienna is to be extended, so as to include all the rooms in the building. The installation now consists of 2,000 incandescent lamps, and the proposed extension will add 2,000 lamps to the present number.

Application has been made for a charter incorporating the People's Gas and Light company, the organizers of which propose to furnish gas and electric light in the city of St. John, New Brunswick. The company is capitalized in the sum of $800,000.

The big new gun factory at the Watervliet arsenal will soon be fully supplied with electric lights. Throughout the north wing of the factory and in the main structure about 250 lights will be placed. In each end and at the center will be one lamp of 2,000 candle power, and 218 lamps of 16 candle power will light the remainder of the building.

The Toronto Incandescent Electric Light company recently gave a formal opening of the new plant at its central station. In the basement were eight Edison dynamos, six of 1,000 sixteen candle power lights and two of 2,000 lights each, the latter being the largest incandescent machines in the Dominion. These supply seventeen miles of underground wires already in operation, and arrangements are completed for laying ten additional miles this summer. Two Armington & Sims high speed engines, one of 175 horse power and one of 300 horse power, and two straight line engines of 175 horse power each, run the dynamos the largest of these giving 260 revolutions per minute, the most powerful high-speed engine in Canada. In the boiler room are seven return tubular boilers of 125 horse power each, built by the John Doty Engine company of Toronto.

The city of Sophia will erect an electric lighting station and utilize the water power of two streams from the Vitoche mountain. These streams will be united by a canal and led into a basin with a capacity of 27,000 cubic meters. By the utilization of this water power there can be secured an available motive force of at least 2,200 horse power, and this capacity is taken as the limit which the electrical works may reach. On account of the great distance between the site of the works and the city, the use of alternating current machines with transformers is preferred, but parties tendering have the option of proposing other systems of distribution, always provided that such systems afford the necessary security for economy and regularity of work. Within the city itself underground cables are to be laid In calculating the leads, it must be remembered that all the squares, streets and lanes at present built are to obtain the electric light, and the possibility must be afforded that with the increase of the town and the growing demand for light, it may be easily and cheaply supplied in new quarters. All the main streets are to be lighted with arc lamps; for the side streets, glow lamps are proposed.

ELECTRIC MOTOR.

It is reported that an electric motor is used on the estate of the Marquis de la Laguna, in Spain, for plowing land. Water power is used to operate the generator, which is located at some distance from the plow.

The largest isolated incandescent electric light installation in Canada is said to be that recently placed in the government printing bureau at Ottawa, by Ahearn & Soper, electricians of that city. There are 1,100 lamps in the building. The power for this plant is supplied by a 150-horse power engine.

ELECTRIC RAILWAYS.

An extensive system of electric railways is to be operated in Birmingham, Ala.

Electricity will be adopted as the motive power of the Bristol, Tenn., belt line.

A five-mile electric road is to be built at Iowa City, Ia, by the Iowa Investment company.

The project for an electric railway between Boston and Lynn now bids fair to become an accomplished fact.

The Westinghouse company will furnish 36 double motor trucks and two 500 horse power generators for the new belt line at Los Angeles, Cal.

The Brownwood, Texas, Improvement company proposes to build eight miles of street railway lines, using electricity as the motive power.

It is reported that the American Loan & Investment company will build an electric road from Macon, Ga., to Belleview, a suburb of that city.

The Metropolitan Street Railroad company of Washington, D. C. is having plans prepared for the erection of a power house to be 122x250 feet and to cost $75,000.

The electrical railway which ascends the Monchsberg, near Salzburg, had carried 66,712 passengers and more than 1,000 000 kilogrammes of goods up to the end of last year. The net profits amounted to 417,411 florins. It has been decided to enlarge the central station at Salzburg.

In concluding an article relating to slow-speed motors for railway work the London *Electrical Review* says: "It is astonishing that American electric traction engineers have only just found out the advantages of protected and self-lubricating gearing, which was advocated and used in England many years ago. Reckenzaun adopted it on his electric car in 1883, and has recommended it ever since."

It is reported that the works of the Electric Traction Manufacturing company of New Orleans have been closed, and the employes, fifty in number, discharged. The attempt made to utilize storage batteries was on the Upper Magazine Citizens' lines, but they did not work successfully. The members of the city council were so sanguine of the success of this enterprise that they refused to grant permission to the Carrolton road to adopt the overhead wire system.

Surveyors are at work laying out a route for an electric railway from Rochester to Fairport, N. Y., a distance of ten miles. Rochester has already an extensive electric street railway system, and is connected with Charlotte, on Lake Ontario, by a similar line In addition there is some talk of an electric road west from Rochester along the Ridge road to Niagara Falls. Altogether it appears that the Flower City may well lay claim to credit for its activity and enterprise in electric traction matters.

The Thomson-Houston International Electric company has sent in a petition to the chief magistrate of Berlin, asking for permission to construct and work an underground electric railway in Berlin. The proposed railway is to be built in iron tunnels similar to the City and South London Railway.

ELECTRIC MINING.

A syndicate of capitalists proposes to erect electrical reduction works at Glenwood Springs and Canyon City, Colorado. The latter plant will cost $250,000. Zinc and other ores of a refractory character will be treated.

The Southwestern Electric Light & Water Power company of Grand Falls, Mo., expects to expend $300,000 before its new plant is completed. An important part of its business will be the furnishing of power to the mines around Blendeville.

As illustrating the great utility of electrically transmitted power in mining operations, the *Financial & Mining Record* cites the case of the Dalmatia mine, Eldorado county, Cal. This mine is situated on the Georgetown divide, one mile east of Kelsey's diggings. The property belongs to several Englishmen, who formerly worked their mill by steam power, but who, finding it too expensive, abandoned steam power, the ore being of such low grade as to yield scarcely more than two dollars per ton. Manager Pearson thought that by using electricity the ores could be profitably treated. He carefully inspected all the conditions of this system and became convinced by introducing it in the mine it would prove highly advantageous to the interests of the owners, and consequently adopted it. The power is generated from Rock Creek ditch, carrying 400 inches of water from the American river. This water is delivered on a seven foot Pelton wheel under a head of 112 feet. The water wheel is belted to a 120 horse power generator, from which the power is transmitted to a motor in the mill, by which all the machinery is operated, consisting of a Dodge rock breaker, three pulverizers, two batteries of five stamps each, and a set of Challenge ore feeders. This electric power has been in use eight months, during which time 30,000 tons of ore have been crushed without any interruption of the generating power, at a cost of about fifty cents per ton.

TELEPHONE.

It is reported that preparations are being made to connect Berlin and Vienna by telephone.

The Spanish government has asked for bids for the construction and operation of a complete network of telephonic lines to be established between the principal towns in Spain.

The Hamilton, Ont., *Herald* says: "The placing of telephone transmitters in churches puts a premium on laziness. A Hamilton man lengthened the wire in his house yesterday morning until he could hold the instrument to his ear comfortably in bed. Snuggling himself up beneath the bed covers he lay all the morning listening to Canon Curran's discourse in St. Thomas church."

The Logan, Utah, *Journal* of March 21st says: "The Rocky Mountain Telephone company has done itself no good in relieving C. F. Annett of the management of that company. Whatever success that corporation has met with is due wholly to the energy and enterprise of Mr. Annett. He is a thorough electrician, full of energy, as popular as any man in the West, and has built all the lines and made all the friends that unpopular company now has. The patent expires in less than three years, and the top-flighty gentlemen of the present company will wish they had retained the services of an efficient man when they appreciate the decline in value of their stock by reason of active competition."

TELEGRAPH.

England's telegraph revenue for 1890 was £2,380,000, an increase of £60,000 over the preceding year.

A dispatch from Detroit says the Postal Telegraph company is about to absorb the Michigan Telegraph company. Negotiations will probably be consummated next week. The Michigan company was organized by Ives and Farnsworth in 1883, with a capital stock of $50,000. They built a line to Toledo and Fostoria. This was purchased by the Bankers and Merchants' company, which failed. In 1885 Ives and Farnsworth organized a new Michigan Telegraph company, and built lines to Bay City, Saginaw, Grand Rapids and Muskegon. It has since acted as a connecting line for the Postal Cable company.

MISCELLANEOUS.

In India a novel application of electricity has recently been made in elephant catching. At a recent capture of forty of these animals, when the last one had passed the entrance into the inclosure, the signal for barring the exit was given by means of an electric current.

Dr. John H. Payne, a celebrated oculist, says: "Most persons who use the incandescent electric light like a new lamp because the light is whiter and more brilliant than after the lamp has been in use for two or three weeks. This is wrong. It is this dazzling white light that harms the eye. An old lamp is the best, for in it the light has become changed to a pale yellow, which is the ideal color. Just as in noonday brightness human sight is not so clear and far-reaching as at the yellow sunset, so a new

incandescent burner is not so good for the eye as the old one. An old burner, so adjusted and shaded that the light from it does not shine in the face, is the ideal artificial light."

A provincial English paper, in describing the electric launches which are to ply on Lake Win ermere, gravely informed its readers that "the amperes and all electrical fittings are Immisch's patents." It is to be hoped that a few of these patented amperes can be secured as a portion of the Eng ish exhibit at the electrical department of the World s Fair.

TRADE NEWS.

H. M. Underwood, general western agent for the Interior Conduit & Insulation company of New York, reports the outlook for business in his territory as being most favorable. Several Chicago buildings are now being fitted up with h s company's tubing.

Manager Ernest Hoefer of the Illinois Electric Material company is justly proud of the new office and salesrooms of his company at 158 Fifth avenue. The company has just moved from the old location at 339 and 341 Rookery, and its new quarters are commodious and attractively fitted up The front part of the store is used as the salesroom, while in the rear are the offices and a big store-room. A portion of the basement is also used for the storage of goods. A feature of the pleasing window display is a wall sign made of Bishop India rubber insulated wire, which is one of the company's specialties. All varieties of electric lighting and railway supplies are furnished by this house.

The headquarters of the Accumulator company and the Electro-Dynamic company have been consolidated in Philadelphia. New and commodious offices have been secured, fronting on Chestnut street, and extending back to Carter street, upon which the factory of the Electro-Dynamic company is located. These offices will be fitted up so as to accommodate the executive officers, the superintendent and the technical departments of both companies, at the same time enabling the factory facilities to be increased to the extent now covered by the Electro Dynamic company's offices. The Eckington & Soldiers' Home Railway company, in addition to its contract for a full equipment of Edco storage battery cars for its G street and Fifth street branches, has recently ordered from the Electro Dynamic company two 40 horse power Edco slow speed dynamos with self-oiling bronze bearings and tempered copper commutators, work on which is being pushed forward as rapidly as possible. The factory of the company is being worked to its full capacity.

BUSINESS.

Thomas L. Townsend, who is representing the Partrick & Carter company of Philadelphia, recently visited Atlanta, New Orleans and Memphis. He reports excellent business.

The Triumph Compound Engine company reports prospects for excellent business. Orders are coming in rapidly, and sales for March were 50% higher than in the corresponding month last year.

The Brown & Sharpe Manufacturing company of Providence, R. I, and Darling, Brown & Sharpe of the same city have jointly issued a very complete catalogue in compact form. These houses manufacture all sorts of hardware but electricians will be especially interested in the standard wire gauge described in the rear portion of the book.

The Northwestern Electrical Specialty company is meeting with gratifying success in the introduction of the Economic incandescent lamp. This lamp has been on the market only a short time, but has been well received, especially in the East, where it was first introduced. It is made from 10 to 75 candle power to fit all the principal bases.

The Ford-Washburn Electric company of Cleveland, O., will shortly put on the market a new storage battery, the invention of Geo. A. Washburn of Cleveland. Mr. Washburn is an electrician of long experience, and has invented and patented some valuable improvements in the art, notably the self-ventilating dynamo and motor now being introduced by his company.

Early in 1889 Mr. Washburn began his experiments in the development of an accumulator on the principle of one now to be offered to the public. His familiarity with the inherent weaknesses and defects existing in other batteries of this class led him to consider principles of construction of a radically different and original character, and it is said that in doing this he has demonstrated that a battery can be made in which the difficulties and objections hitherto encountered are overcome.

In several well-known types of batteries, lead supports for the active material are employed. These plates make the battery excessively heavy, and when subjected to severe strain, such as is constantly occurring in street car work, the plates warp and buckle. In the Washburn battery no lead supports are used. The lead-plate batteries as a rule have the active material pressed into various shaped apertures in the plates themselves, or affixed to their surface by mechanical pressure. The process of charging and discharging is exceedingly trying and the consequence is that in a very little time the active material, both by reason of the warping and buckling of these plates and by the speedy disintegration of the material itself, soon falls to the bottom of the cell, destroying the usefulness of the plates. A number of inventors have attempted to devise some peculiar form of aperture or pocket in the plates wherein the active material could be forced to remain and a vast amount of ingenuity has been displayed and expended in this direction. Mr. Washburn, however, has devised an entirely different and novel construction, wholly obviating, it is claimed, the difficulty described, by dispensing with all use of lead supports with affixed active material. In this battery the active material lies in contact with the positive and negative electrodes, but is not mechanically fixed thereto. There is no such aggregation of plates as in these other types of batteries. The active material is so confined, it is claimed, that it cannot possibly leave its chambers, the weight of the lead plate batteries is a serious objection. It is asserted that the Washburn battery weighs from 33 to 50 per cent. less than other batteries of the same storage capacity.

ELECTRICAL PATENTS.

Issued April 7, 1891.

449,655. Telegraphy. Frank Anderson, Peekskill, N. Y.
The last claim is:
"9. An instrument designed for learners' use consisting of an embossed record fillet supported by a guiding arm, a pivoted arm located at substantially right angles to said fillet, its free end adapted to be carried forward by the embossments thereon, in combination with front and back contact stops, and an adjustable retractile spring attached to the movable arm."

449,660. Automatic Switch for Electric Motors. William Baxter, Jr., Baltimore, Md.

449,661. Electrical Hoisting Machine. William Baxter, Jr., Baltimore, Md.

449,662. System of Operating Electric Elevators with Landing Switches Only. William Baxter, Jr., Baltimore, Md.

449,672. Train Signal. Hugh J. Finn and John A. Garner, Kansas City, Mo.

449,679. Multiplex Telephony. William W. Jacques, Newton, Mass.
The invention consists in connecting up at each end of the circuits the three or more line wires with an equal number of Muirhead condensers and an equal number of telephone loops, each line wire making connection with the armature strip of a separate condenser, and each loop making connection with the conducting strips of two condensers.

449,685. Electrical Switch-Board. John B. Lyon, Brooklyn, N. Y.
Claim one reads:
"The combination, with a multiple switch-board, of the wires which connect all the sockets in any given row of the switch-board united into a web or band."

449,688. Speed Regulator. Alfred B. Morse, Easton, Mass.

449,690. Non-Interference Electrical Signaling Apparatus. Abraham Newman, Brooklyn, N. Y.

449,709. Propelling Mechanism for Electric Motor Cars. Sidney H. Short, Cleveland, Ohio.

449,715. Electric Arc Lamp. Elihu Thomson and Edwin W. Rice, Jr., Lynn, Mass.

449,719. Electric Search Light. Barton B. Ward, New York, N. Y.

449,721. Electric Connector. George K. Wheeler, Chicago, Ill.

449,726. Process of and Apparatus for Separating Ores Magnetically. Clinton M. Ball, Troy, N. Y., and Sheldon Norton, Hokendauqua, Pa.

449,731. Automatic Electric Block System. Joseph A. Carlton and Henry L. Johnston, Atlanta, Ga.
This invention relates to a system of indicating by the automatic making and breaking of electrical lighting circuits the presence of a train of cars in a block division of a railway, or the exit of said train therefrom, and the resultant clearance of the block, which produces an automatic electrical block system for railways.

449,752. Electric Motor Car. Harold P. Brown, New York, N. Y.

449,753. Pole for Overhead Systems of Electric Railways. John N. Brownlee, Detroit, Mich.

449,759. Time Stamp Actuated by Electro Magnets. Warren B. Martindale, Kenosha, Wis.

449,766. Ammeter or Voltmeter. Harold C. Shubert, Chicago, Ill.

449,767. Cut-Out. Alfred T. Tregurtha, Everett, Mass.
The first claim is:
"The combination, with a base having electric contacts thereon for connection with the main wires of the electric circuit, and a lamp having its electric wires each connected to an independent electric contact on said base, by which wires the lamp is suspended and supported, of a cap or cover having electric contacts on its inner side, each two connected by a separate fusible electric wire, and said electric contacts being arranged to engage with and to be connected to the electric contacts on said base to make electric connection therewith, and to secure and hold said cap or cover in position on the base."

449,773. Insulator Pin Machine. Abel D. Catlin, Chattanooga, Tenn.

449,774. Commutator for Electric Motors. Henry Duenner, Boston, Mass.
The improvement consists in mounting the brushes upon a spindle which is movable longitudinally and applying thereto cross-head slides and an adjusting screw so that by a single turn of the screw the brushes may be adjusted longitudinally.

449,780. Circuit Breaker for Incandescent Electric Light Systems. Friedrich Muller and James G. Greene, Elizabeth, N. J.
The invention has for its object to provide an automatic circuit breaking device for an incandescent electric light system, said device being of such character that it will allow a predetermined number of lamps to burn without interruption, but will immediately break the circuit and extinguish the lamps if more than the predetermined number of lamps are turned on. It will, however, permit the authorized number of lamps to be immediately relighted by moving a lever or similarly manually operated device after the surplus lamps have been turned off.

449,792. Electric Railway. Edward M. Bentley, New York, N. Y
This invention pertains to electric railways of the kind in which the main supply conductor is supported above the roadway and electrical connection between it and the vehicle maintained by means of a contact device traveling along the conductor and connected to the vehicle on the roadway below.

449,797. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

449,829. Auxiliary Fire Alarm and Extinguisher System. Eason L. Slocum, Pawtucket, R. I.

449,832 Bell. Arthur F. Stanley, New York, N. Y.

449,836. Method of Electric Welding. Elihu Thomson, Swampscot, Mass.
The last claim reads:
"4. The herein described improvement in electric welding operations, which consists in forming the weld by the application of the electric current and end pressure, permitting the metal to cool, and then reheating the metal and applying pressure so as to upset the heated metal to either side of the weld preliminarily to the application of the hammering, rolling, or other operations designed to restore the fibrous character of the metal."

449,843. Electric Car Stopping Device. George W. Blanchard, Waterville, Me.

449,847. Electrical Dental Engine. Frank F. Eggers, San Francisco, Cal.

449,866. Automatic Bell Ringer. William W. Slater, Oakland, Cal.

449,886. Trolley Support for Electric Cars. Frank Robinson and Percy W. J. Lander, Bangor, Me.

449,889. Electric Valve Controller. George E. Turner, Marion, Ohio.

449,890. Apparatus for Electroplating Small Articles. Frederick W. Zingsem, New York, N. Y.

449,897. Telegraphy. Robert G. Brown, Brooklyn, N. Y.
This invention relates to that class of telegraphy in which there are two synchronously revolving trailers, one at each station, and connected by the main line, and two or more local lines connected with the main stations, so that the main line can be made use of by either of the parties having instruments in the local lines.

449,902. Support for Electric Lamps. James W. Easton, New York, N. Y.

449,903. Lightning Arrester. James W. Easton, New York, N. Y.
The invention relates to that class of lightning arresters which comprises two electrodes, one connected with the working circuit and the other having a ground connection, separated sufficiently to prevent the passage of the working current under ordinary conditions, but not enough to oppose any material resistance to the passage of the abnormal current caused by the lightning stroke.

449,921. Electric Cut-Out. Alfred T. Tregurtha, Everett, Mass.

449,923. Electrical Type Writing Machine. Edward F. Youngs, West Camp, N. Y.

449,943. Insulator. Louis McCarthy, Boston, Mass.

449,977. Supporting Post for Electric Conductors. William A. Stern, Allegheny, Pa.

449,990. Automatic Railway Signal. Calvin W. Wilhelm, Mauch Chunk, Pa.

450,000. Electric Lamp for Street Lighting. Hiram H. Carpenter, Chicago, Ill.

450,068. Electrical Lock. Heinrich Grefen, Oberhausen, Germany.

450,074. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.
Of the nineteen claims the second is given:
"The combination of a railway track, a series of posts arranged along the side of said track, supply and working conductors connected in parallel and supported by said posts at a distance above the track, a traveling car, an electric motor to propel the car, and an upwardly extending and laterally movable current collector for making contact with the working conductor for supplying current to the motor on the car from the supply conductor."

450,101. Cut-Out. Jacob S. Gibbs, Hartford, Conn.
The invention relates to the class of cut-outs for multiple incandescent lamps having a base bearing pole pieces or contacts for the main leads of the circuit and a detachable cap bearing lamp wire connections and safety fuses."

450,103. Electrolytic Apparatus. Ernest A. Le Sueur, Ottawa, Canada.

450,104. Electrolytic Cell. Ernest A. Le Sueur, Ottawa, Canada.

450,105. Carbon Electrodes for Electric Batteries. Ernest A. Le Sueur, Ottawa, Canada.
The claim reads:
"An electrode for an electrolytic cell consisting of a number of pieces of rough carbon cut to equal lengths, and having rough uncut sides and a metallic backing in which said carbon pieces are embedded at one end."

450,116. Three Rail Track for Cable Railways. Chas. Vogel, San Francisco, Cal.

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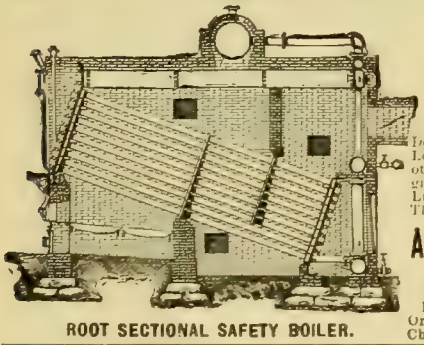

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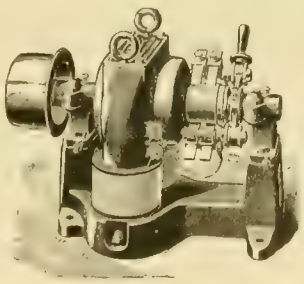

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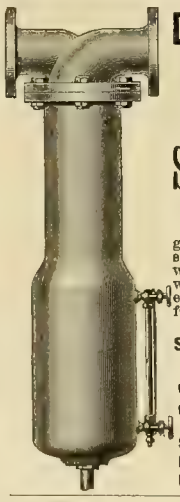

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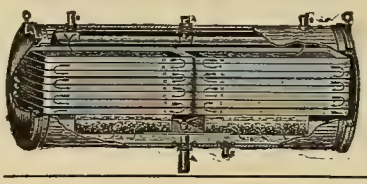

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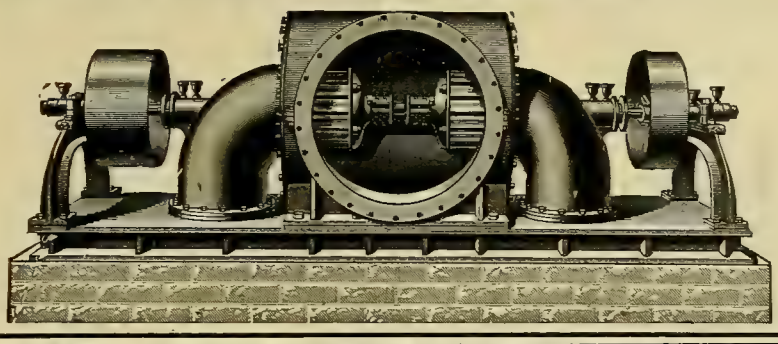

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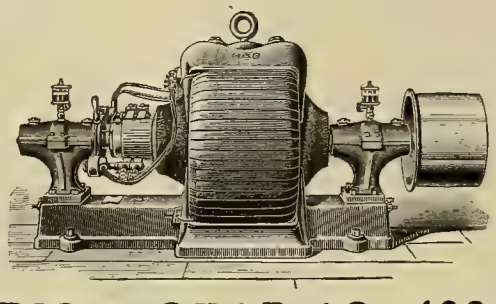

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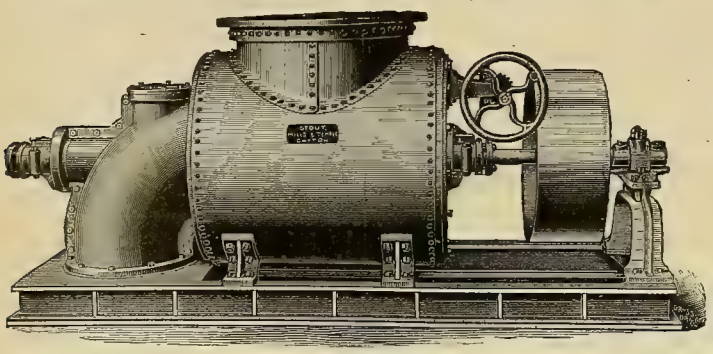

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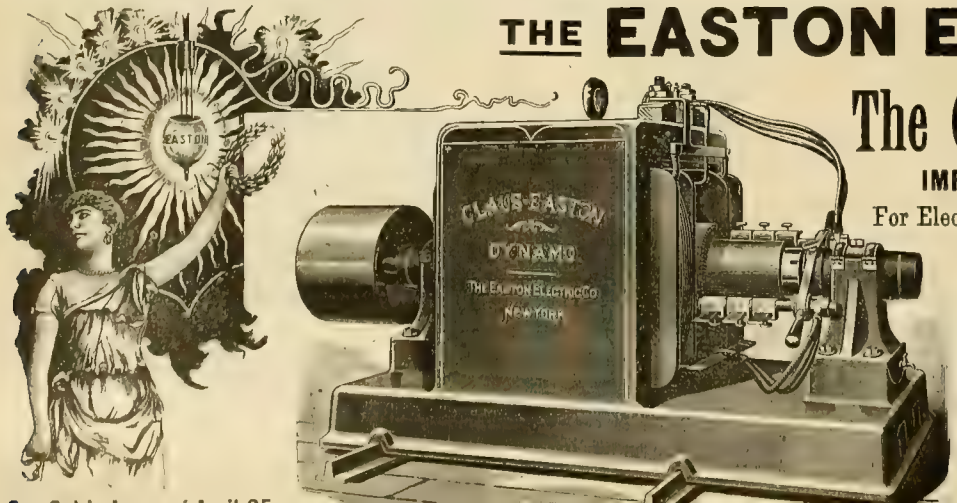

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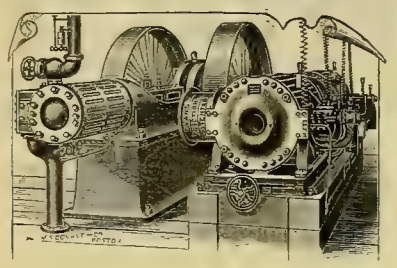

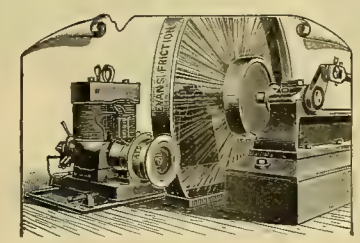

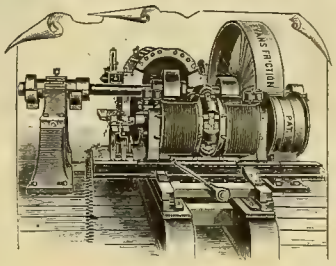

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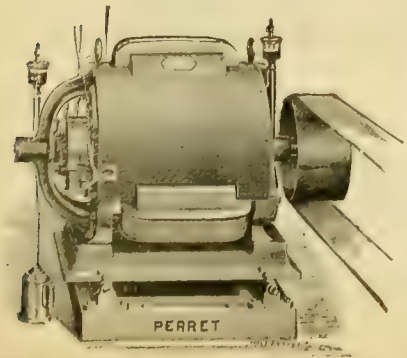

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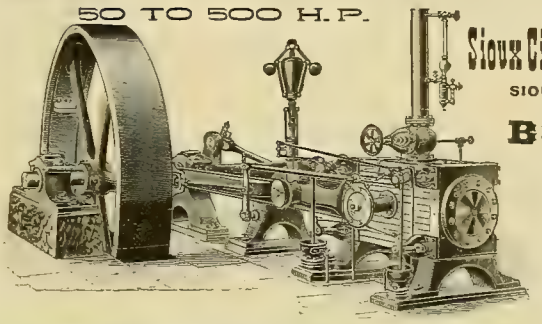

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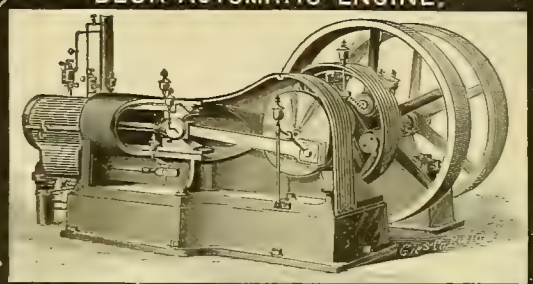

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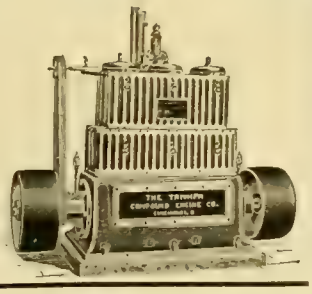

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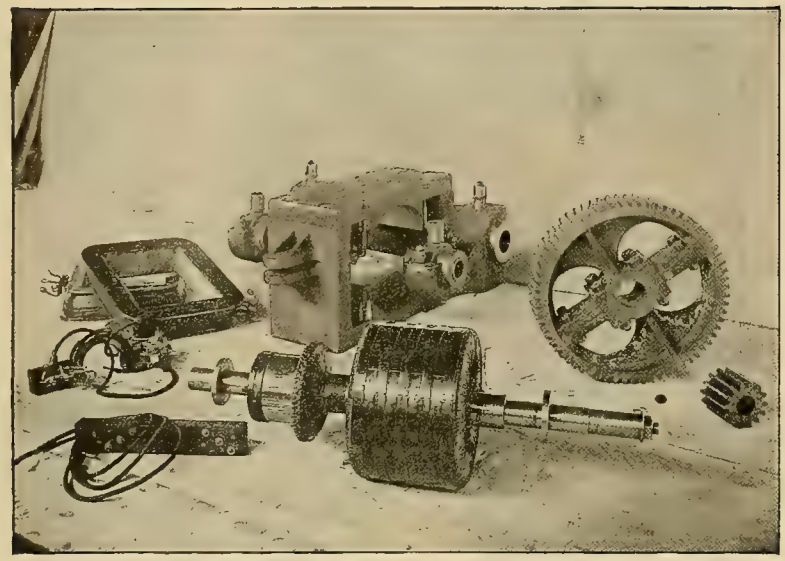

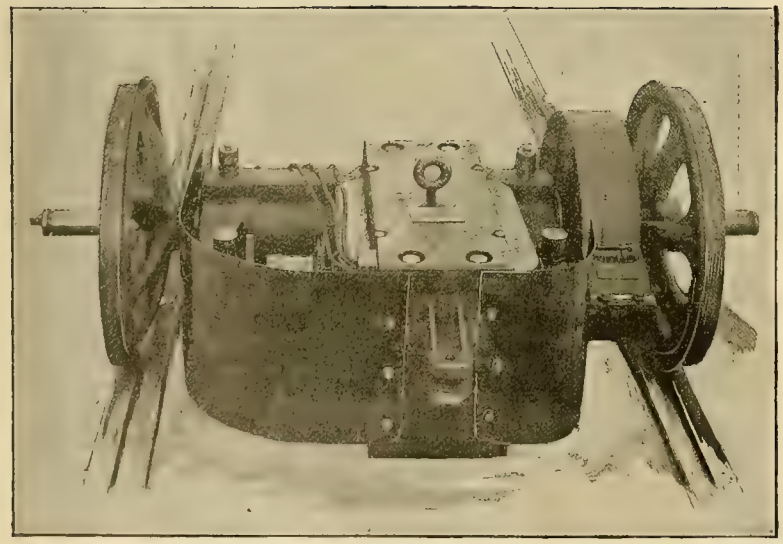

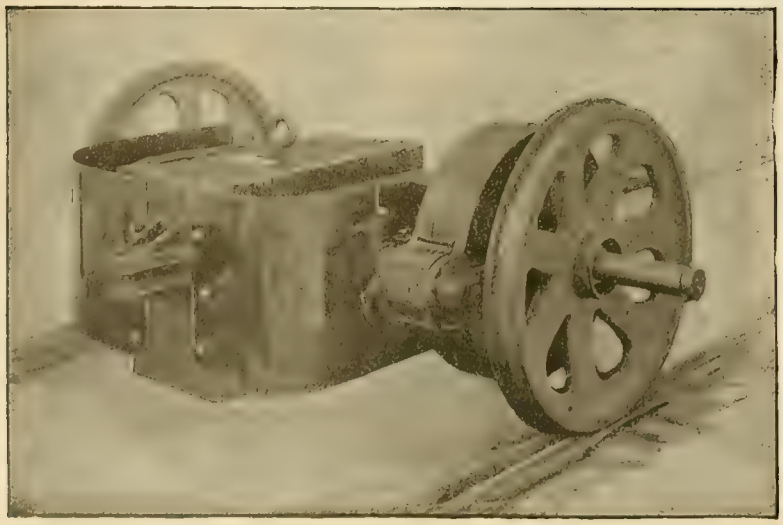

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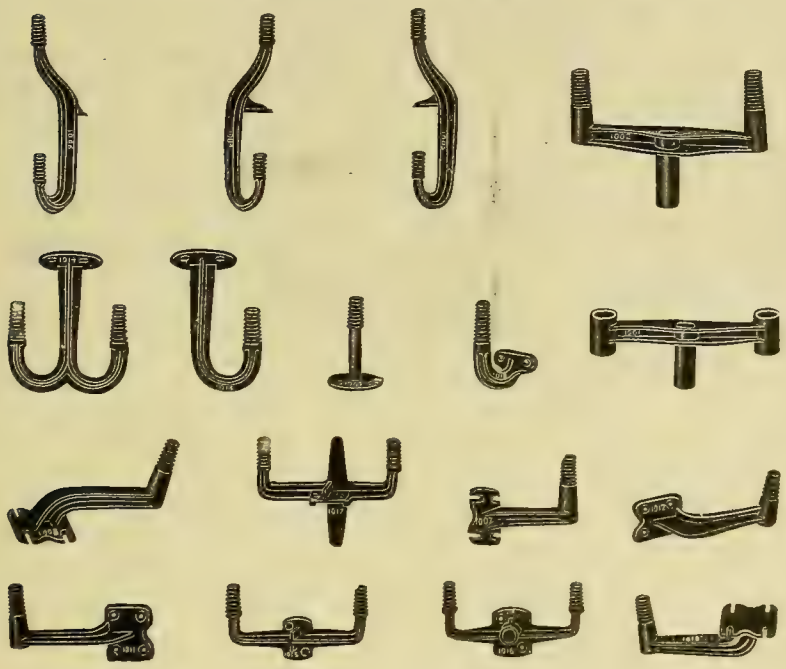

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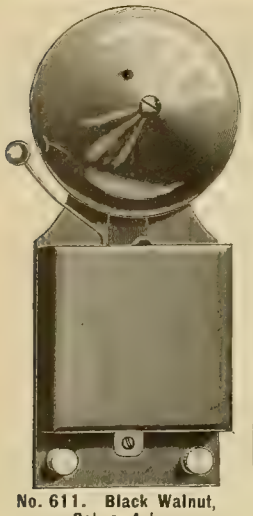

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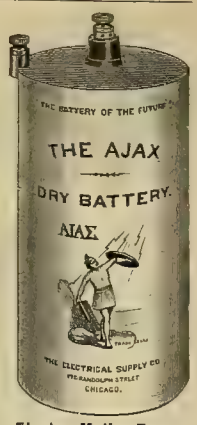

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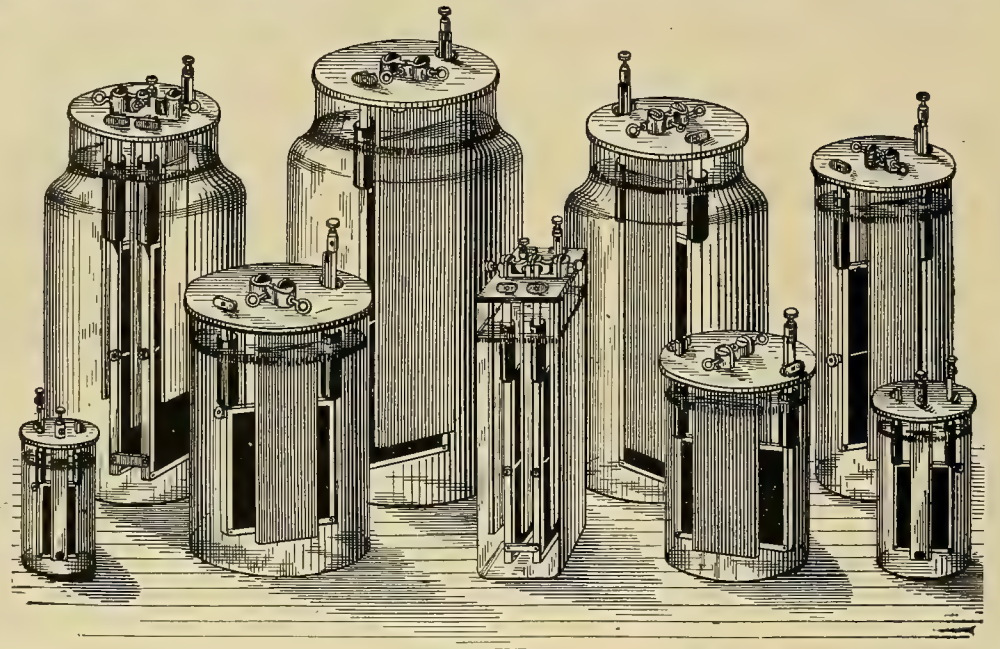

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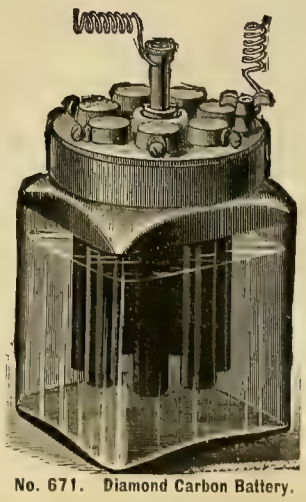
8th. The EDISON-LALANDE is made in 9 different types, each one of which is especially designed for the kind of work named.

No. 641. Iron Box.



No. 671. Diamond Carbon Battery.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive, and unsatisfactory.

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The public is warned against the use of infringing lamps or any crude substitute for the Brush invention.

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ALTERNATING CURRENT APPARATUS.
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CARBONS FOR ARC LIGHTING,
ETC, ETC, ETC.

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FORT WAYNE ELECTRIC CO.,

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Slattery Induction and Wood Arc System

OF

Electric Lighting.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

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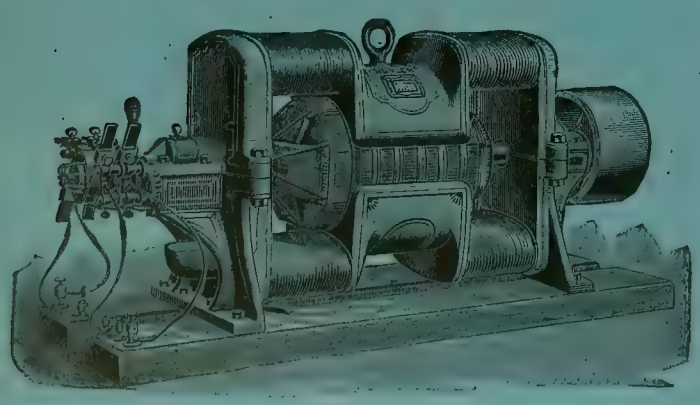
ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES.



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GEARS RUN IN OIL.

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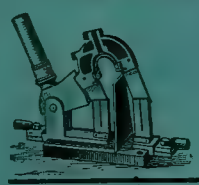

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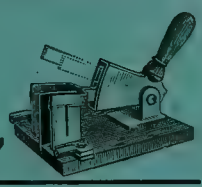

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THE STANDARD UNDERGROUND CABLE CO., Manufactures a Superior Line.

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See Page XXVI.

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THE TRADE WILL BE PROPERLY PROTECTED.

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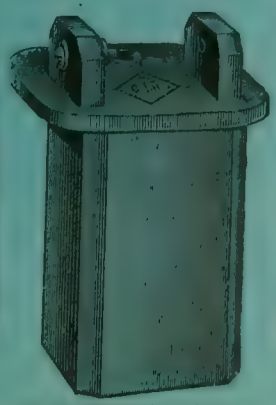
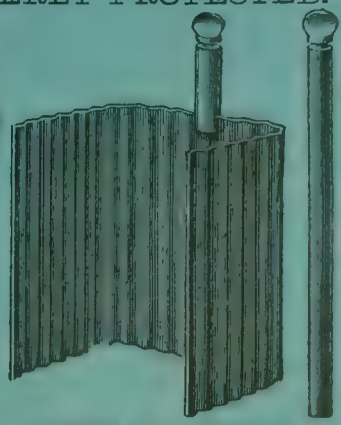


Carbon Reservoir and Cover of Champion Battery.



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OF ALL DESCRIPTION.

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NOTE THE CONTRAST!!

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8,355	MONTANA,	145
4,100	NORTH DAKOTA,	375
3,100	NORTH CAROLINA,	1,183
15,555	TOTAL,	1,703

NINE TIMES as many of the Thomson-Houston System as of

ALL OTHERS COMBINED.

The figures referring to "total of all systems," taken from table published in August number of "Electrical Industries," for year 1890, are of undisputed accuracy.	Total of all systems.	Thomson-Houston System.	
		Number.	Percentage to total of all systems.
Montana, - - - -	8,500	8,355	$98\frac{3}{10}$ per cent.
North Dakota, - - -	4,475	4,100	$91\frac{3}{5}$ per cent.
North Carolina, - -	4,283	3,100	$72\frac{3}{10}$ per cent.

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Queen & Co.
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Stearns Mfg. Co.
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Fire Alarms.
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Stanley & Hall.
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Thomson-Houston ElectricCo.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.
Wilson, Rebenstock & Co.
Wollensak, J. F.
Globes and Electrical Glassware.
Baggot. E.
Great Western Electric Supply Co.
Phœnix Glass Co.
Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.
Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Butler Hard Rubber Co.
Central Electric Co.
Cutter, Geo.
Electric Merchandise Co.
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Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Monitor Electric Co.
Munsell & Co., Eugene.
Partrick & Carter Co.
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Standard Paint Co.
St. Louis Electrical Supply Co.
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Insulated Wires and Cables Magnet Wire.
American Electrical Works.
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Interior Conduit & Insulation Co.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
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Standard Underground Cable Co.
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Lamps, Incandescent.
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Mining Apparatus, Electric.
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Edison General Electric Co.
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Detroit Electrical Works.
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Palmer Bros.
Shawhan Machine Works.
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Great Western Electric Supply Co.
Holmes, C. H.
Standard Electrical Works.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.
Poles.
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Central Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
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Milliken Bros.
Wisconsin Bridge & Iron Co.
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Electrician Publishing Co.
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Central Electric Co.
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Fletcher & Fletcher Electric Co.
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Northwestern Elect. Specialty Co.
Partrick & Carter Co.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.
Railways, Electric.
(See electric railways.)
Separators, Steam.
Pond Engineering Co.
Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Western Electric Co.
Wollensak, J. F.
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Tapes, Insulating.
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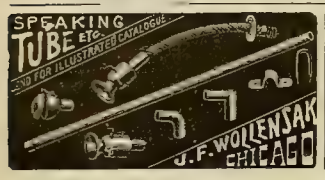

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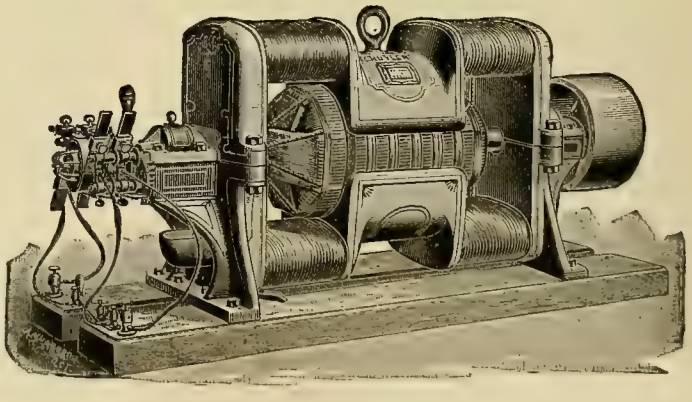

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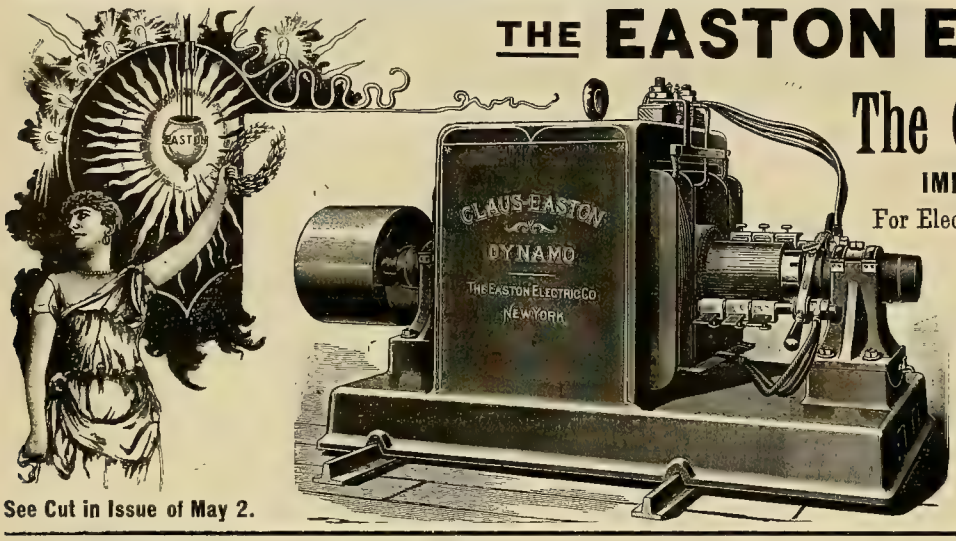

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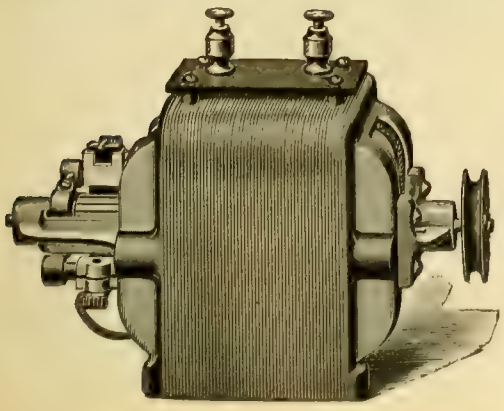

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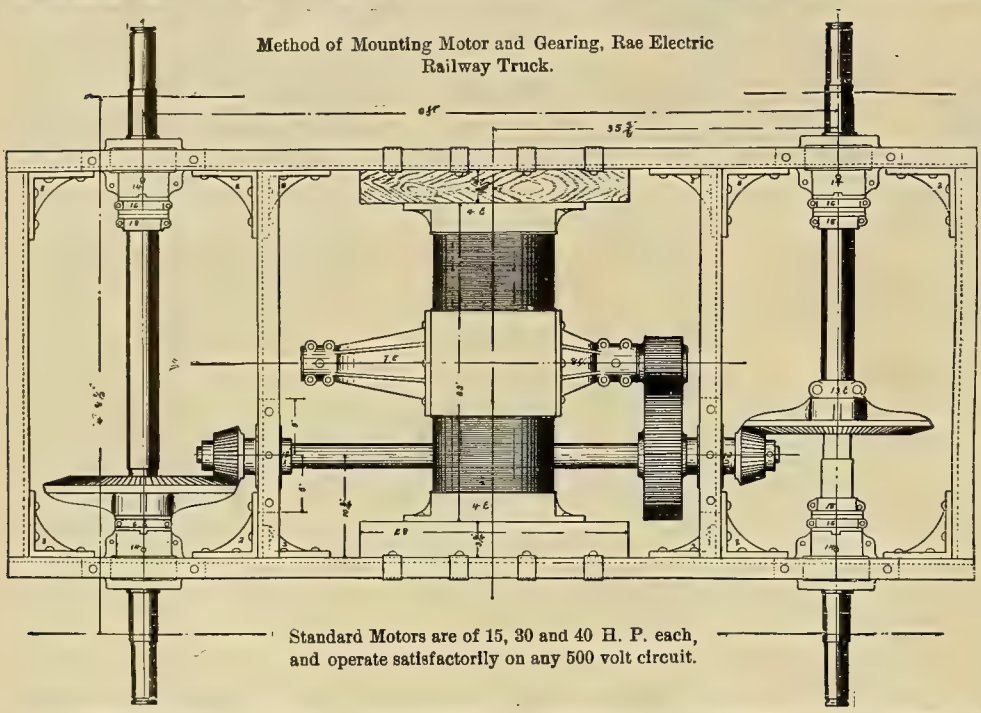

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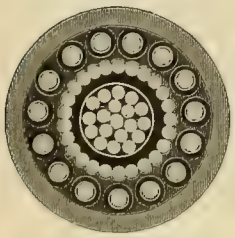

Underground Core.

Feeder Cable, Brooklyn Edison Electric Light Co.

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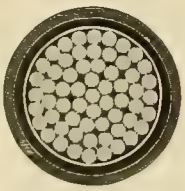
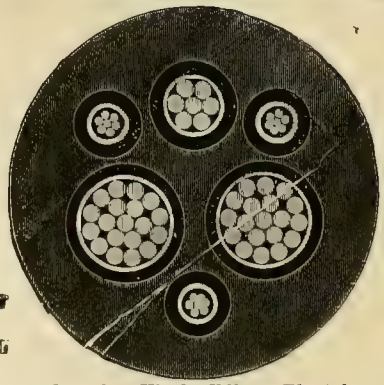


Feeder Core, Broadway Theater.



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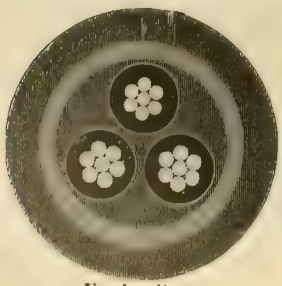

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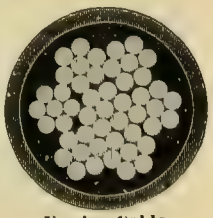

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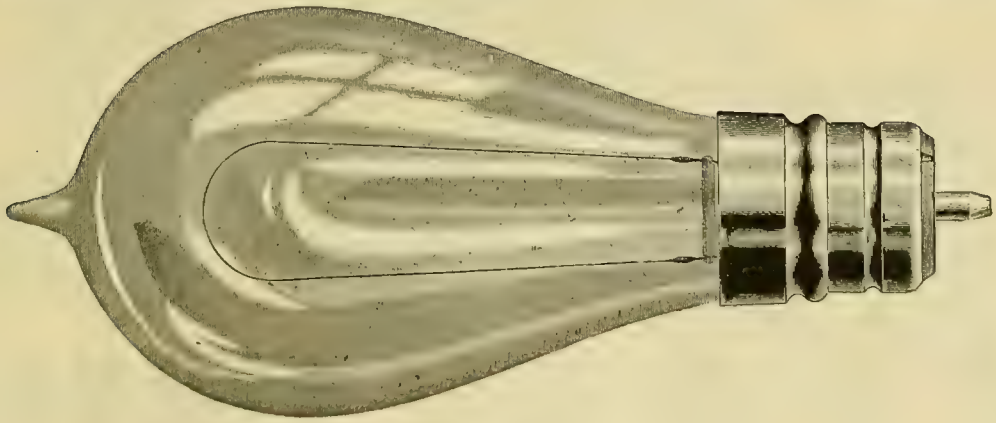

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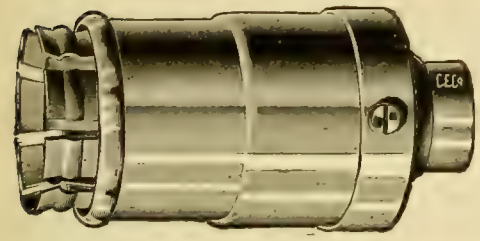

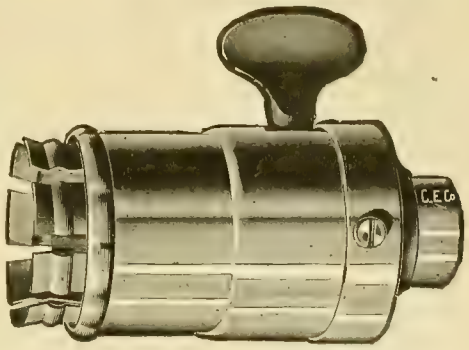

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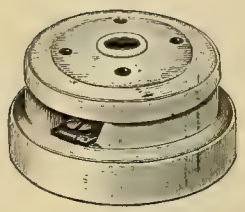

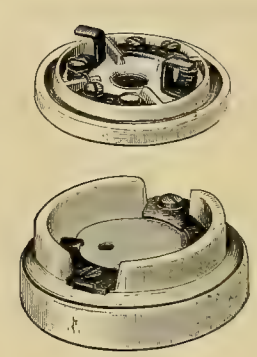

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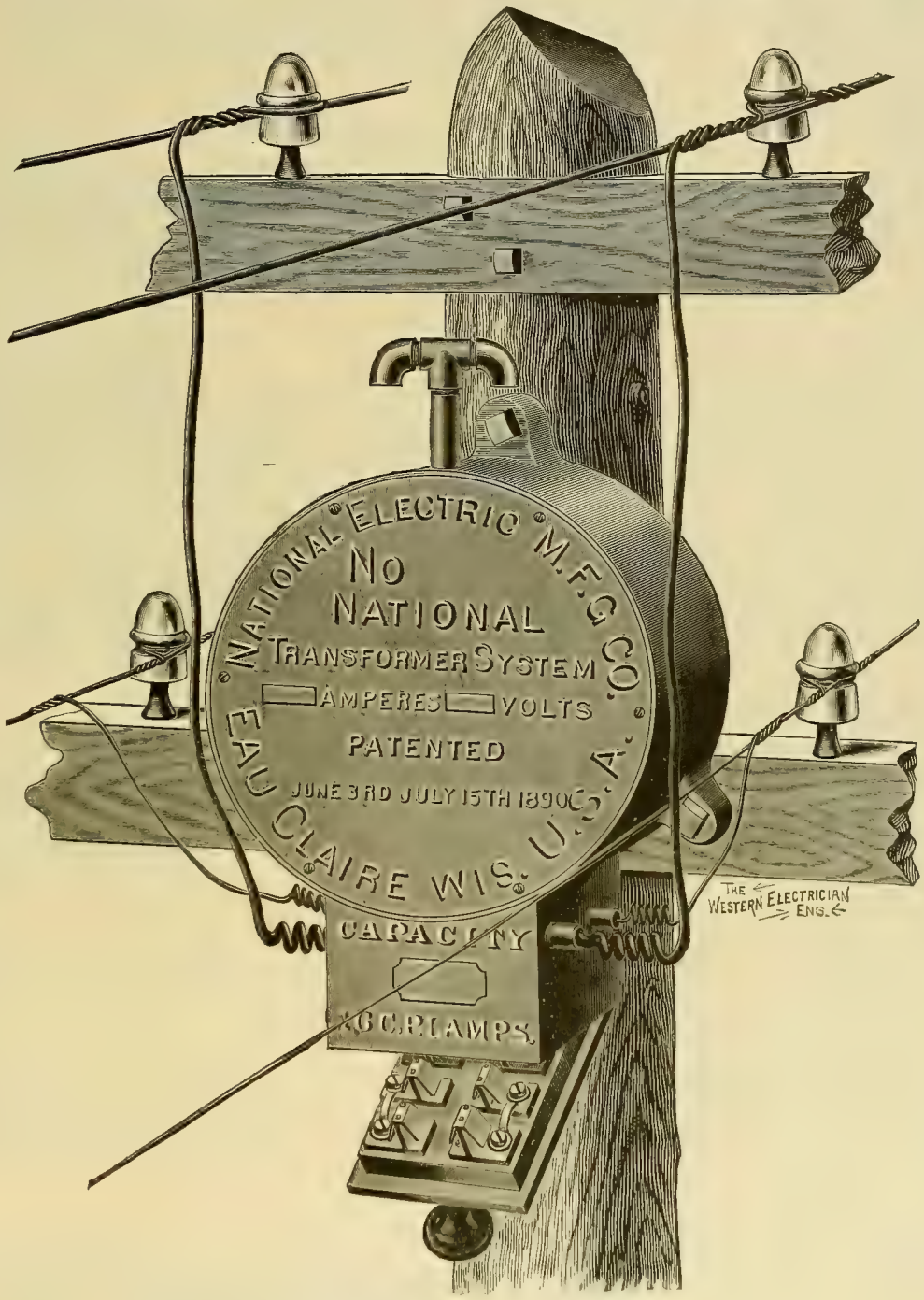

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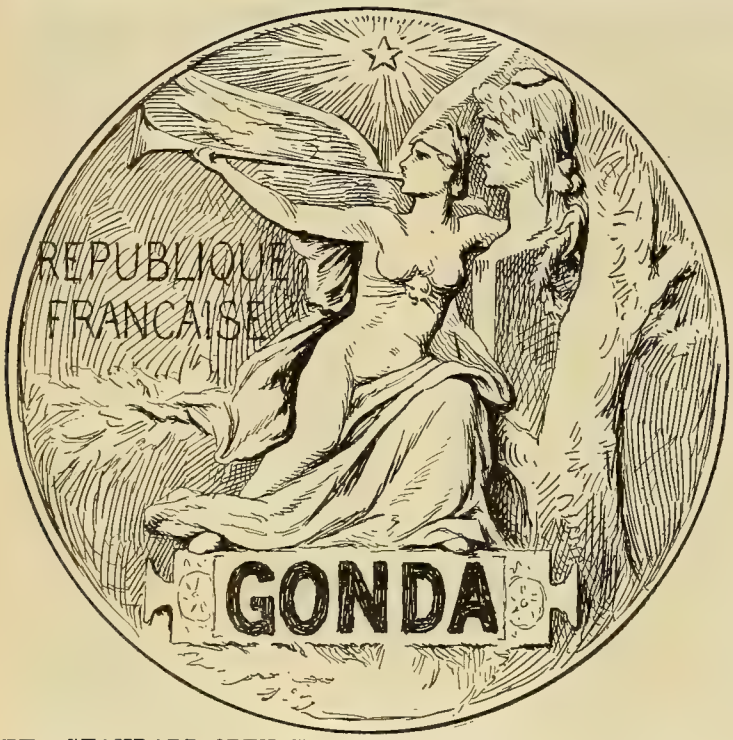

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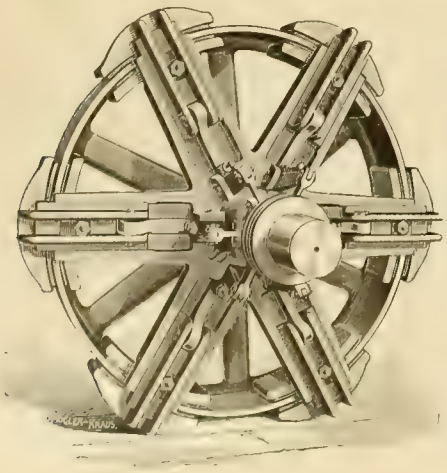

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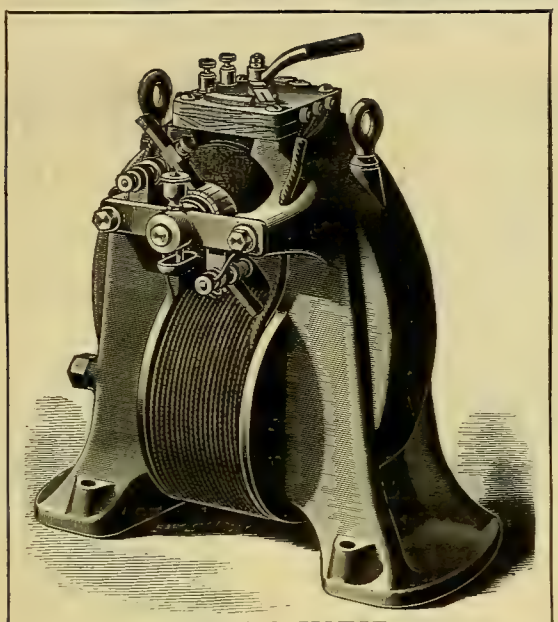

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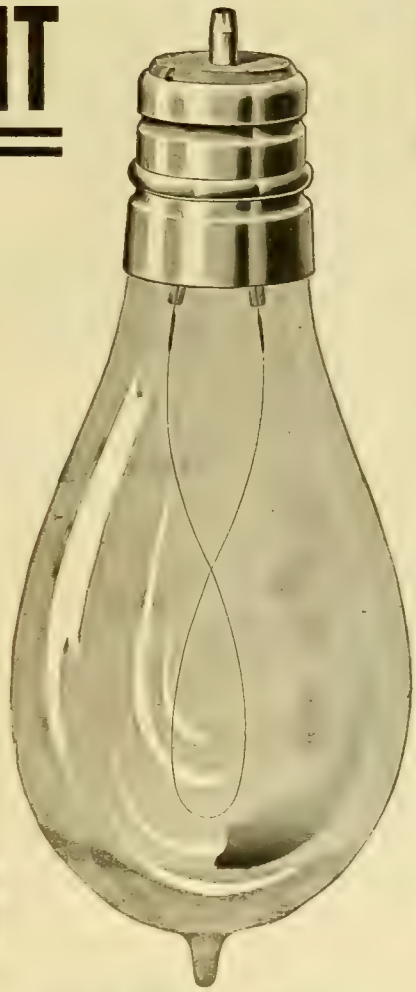

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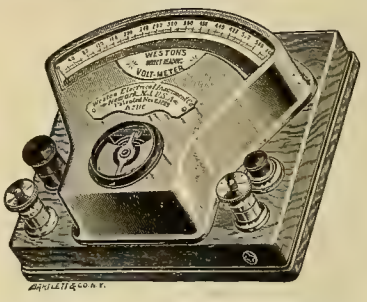

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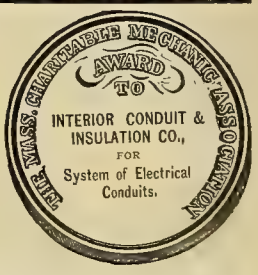

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Vol. VIII. CHICAGO, APRIL 25, 1891. No 17

Fred. E. Degenhardt.

Fred. E. Degenhardt, who was chosen chairman of the Board of Managers of the Chicago Electric club last week, is one of the most popular members of that organization, and one of the most widely known members of the fraternity. Since the organization of the club he has been prominently identified with all its work and has contributed largely to its success. He has devoted considerable time to the club and has read several papers on electrical subjects before that organization.

Mr. Degenhardt was born in Chicago in 1856 and received his early education at Dyrenforth's college, which, "before the fire," was one of the best known educational institutions in the West. On completing his education Mr. Degenhardt engaged in making surgical instruments, but later became interested in electrical work. He was appointed superintendent of the Northwestern Electric Light company, Chicago, and later was made general manager. He was identified with this company for six and a half years and then resigned to take a position with the Western Electric company, Chicago, as contracting agent. Six years ago the Standard Underground Cable company of Pittsburg offered Mr. Degenhardt the position of western manager with headquarters in Chicago. He is still representing that corporation and covers everything west of the Allegheny mountains. He has been successful in all his undertakings. His efforts have not been confined to the commercial side of the business exclusively. He has done considerable experimental work, and has brought out a number of excellent improvements in underground construction. At present he is working on a system of underground electric railway conduits. Mr. Degenhardt claims the distinction of exhibiting the first phonograph seen in Chicago.

In 1885 Mr. Degenhardt married Miss Emily C. Lockwood of Tarrytown, N. Y.

FRED. E. DEGENHARDT.

Chicago Telephone Service.

It now appears unlikely that Senator Thiele's bill regulating telephone charges in the state of Illinois will become a law. The bill was sent to the senate committee on mining and labor, and there referred to a sub-committee of five. After listening to the arguments of those interested four of the members of this sub-committee have reported against the passage of the bill on the ground that the proposed measure is unjust and if passed would work injustice to the telephone companies of the state. They have prepared a long report in which they treat the telephone question exhaustively and show that while the system is in a state of growth any reduction of rates would not be in the interest of the public. Mr. Manecke, the remaining member of the sub-committee, says that he thinks the reductions proposed in the Thiele bill are too sweeping, but that telephone companies may be properly regulated by statute and that a bill should pass in which the reductions proposed should not be greater than $25. It is probable that the majority of the members of the legislature will take the view advanced by the majority of the sub-committee.

The principal effect of the bill, if enacted, would be felt in Chicago, where telephone rates would be reduced from $125 to $80 per year. General Superintendent Wilson of the Chicago Telephone company says that the work of improving the service of the company now going on has already been put back two months by the possibility of the passage of the bill. This company has so far spent $500,000 in improvements and Mr. Wilson says that a total expenditure of $3,000,000 is contemplated. Of course the stockholders are not very eager to come forward with this amount of money if there is a possibility that the revenue of the company will be cut down to such an extent that the improved service could only be maintained at a direct loss, and this natural feeling of timidity on the part of the stockholders will be only slightly lessened if the bill is defeated by a narrow margin, as the result might be otherwise with a succeeding legislature.

The improvements already completed include the big new switch-board at the central office, which is wired for 5,400 subscribers, all on metallic circuits. Of the nine branch exchanges in Chicago three are now supplied with switchboards for metallic circuits. The work of making a similar improvement at the north side station has just been begun. This station is inside the "underground district," and here, as at the other offices, it is hoped to conclude the underground work about the same time that the system of metallic circuits is ready for operation. The work of laying underground telephone cables is as yet largely an experiment, however, and unforeseen difficulties are constantly encountered. When one of these obstacles intervenes the work has to be dropped, of course, until the company's engineers can provide some means or device to meet the emergency, and thus the work proceeds slowly and tediously. Mr. Wilson says that the cost of the underground wire system is twenty times that of overhead poles and wires.

Many of the facts given above are recited in the majority report of the sub-committee already alluded to. In addition, the report concludes as follows:

As the committee considers the improvement and perfection of the telephone service in Chicago of much more importance than a slight reduction upon the annual rate paid by each telephone subscriber, it believes that any action on the part of the legislature tending to hinder or prevent such improvements would be a serious injury to the business public of Chicago, and particularly to the telephone subscribers. While this consideration should be of great weight at any time, it is of special importance at this particular time when the telephone company is about to be called upon not only to provide for the ordinary business of the city, but also to furnish the greatly increased facilities necessary to meet the demands growing out of the world's exposition and the immense volume of business necessarily attendant upon it.

For the purpose of comparison it may be stated that the rates now charged in Chicago are as low as those in any city of the United States of anything like the same area and population, and that in New York and Boston—the only large cities in which the underground system like that now in construction in Chicago is used—the rates charged for such underground service are considerably higher than those charged in Chicago. The annual rate in Boston is $1,800 per telephone and in New York $2,500 per telephone. While your committee does not regard these figures as conclusive, they are cited as showing that in cities where such underground work has been completed and put into general operation it has been found necessary to charge much higher rates for the services afforded than for services on overhead lines, whose cost is very much less than that of underground lines. It may be that at some future time when the entire city of Chicago has been supplied with a perfect underground system, the profits of the business on the capital then invested will still be so large as to be the proper subject of legislative interference, but at this time, when immense investments have still to be made, your committee believes that such interference would be unwise, impolitic and against the best interests not only of the public of Chicago, but of the patrons of the Chicago Telephone company. We therefore recommend that the bill under consideration be adversely reported and that the bill in relation to the rates charged for telephone service in the State of Illinois be passed at this session.

Patent Lawyers Interested in an Appointment.

A committee of the Chicago Patent Law Association, consisting of L. L. Bond, Ephraim Banning, C. K. Offield, J. W. Munday, C. C. Linthicum and J. W. Dyrenforth, visited Washington recently, called upon the president and presented resolutions, previously adopted by the association, respecting the appointment of a new United States circuit judge. The matter was fully discussed and the president said that in making the appointment suggestions by the committee should receive due consideration.

Among the attractions of the coming Frankfort electrical exhibition will be a panorama entitled, "Entrance of a North German Lloyd Steamship into the Harbor of New York." The authorities of the exhibition say that the spectator "thinks himself on the quarter-deck of the steamer Lahn, which is just on the point of entering New York harbor, and he is surrounded on all sides by the wonderful life and commotion of the Empire city. By the electric lighting of the circular picture and of the lower decks the panorama becomes a fit subject for an electrical exhibition."

Electric Street Cars in Buda Pesth, Hungary.

The views presented herewith show the most interesting features of what is claimed to be a successful electric street car line on which the motors take current from conductors laid in a conduit below the level of the rails. This is the Buda Pesth line, which was constructed by Siemens & Halske of Berlin.

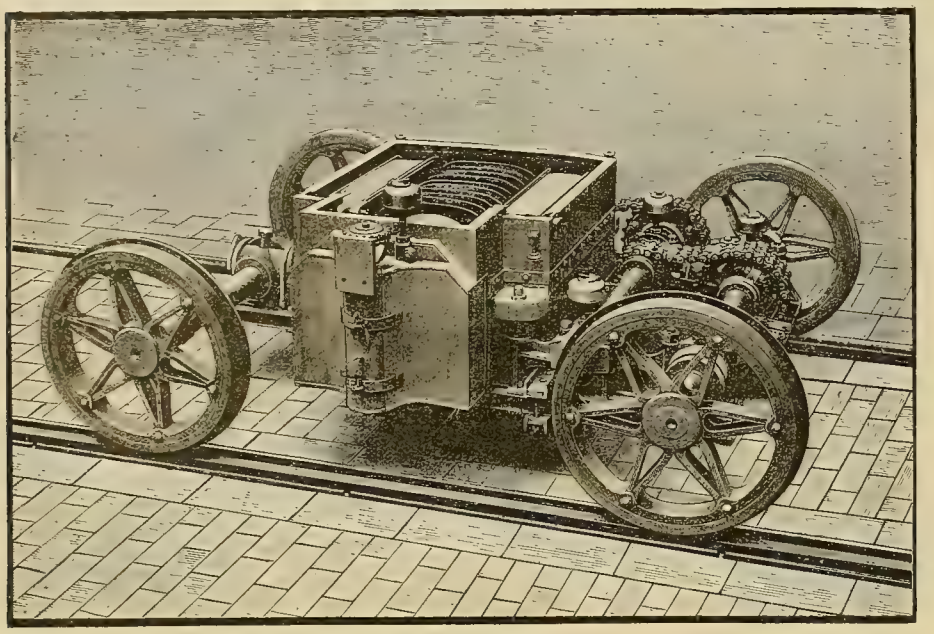


FIG. 3. ELECTRIC STREET CARS IN BUDA PESTH, HUNGARY.

Fig. 1 is a sectional view of the track. Two double rails are set as shown, so as to leave an opening or slit 1¼ inches in width. Under the one rail is a conduit 12¾ inches deep and 10¾ inches wide. This conduit is built in a manner very similar to cable conduits. Cast iron frames are laid at intervals of 46 inches, the intermediate space being built up with cement and concrete. The iron frames serve as supports for the rail, and have on the inside of each, porcelain insulators to which V shaped iron conductors are fastened. It is claimed that if of sufficient conductivity, an iron conductor affords more strength, less wear and a better contact for the sliding brushes, than copper or brass. The two conductors, one positive and the other negative, are by their position in the conduit entirely protected from surface water and moisture. The water runs out of the bed of the conduit to cess pools located at frequent intervals, thence it is carried to the sewers. As the conduit has only a slight depth and is laid near the level of the rail there is no danger of the water from the sewers rising and overflowing it.

Fig. 2 is a view of the yard of the factory where the conduits are fitted together and the cars experimentally passed over them.

Each car has its own motor. The type of motor employed is the old style Siemens & Halske flat machine, in which the field magnets are made of flat wrought iron bars placed side by side, Fig. 3. The armature is the ordinary Heffner-Alteneck drum armature wound for a 300 volt current. For transmitting the motion of the armature to the wheel shaft heavy sprocket wheels and chains working over an intermediate countershaft are used. The motor is entirely boxed up so that no mud or water from the street can come in contact with any part of it. Two doors in the casing on the commutator side of the motor make the machine accessible to the motor man in case of adjusting or replacing the brushes. The brushes are fixed on a movable frame with a gearing which

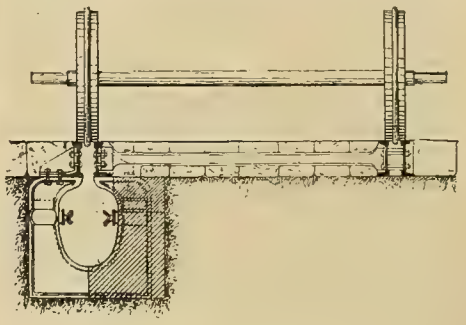


FIG. 1. ELECTRIC STREET CARS IN BUDA PESTH, HUNGARY.

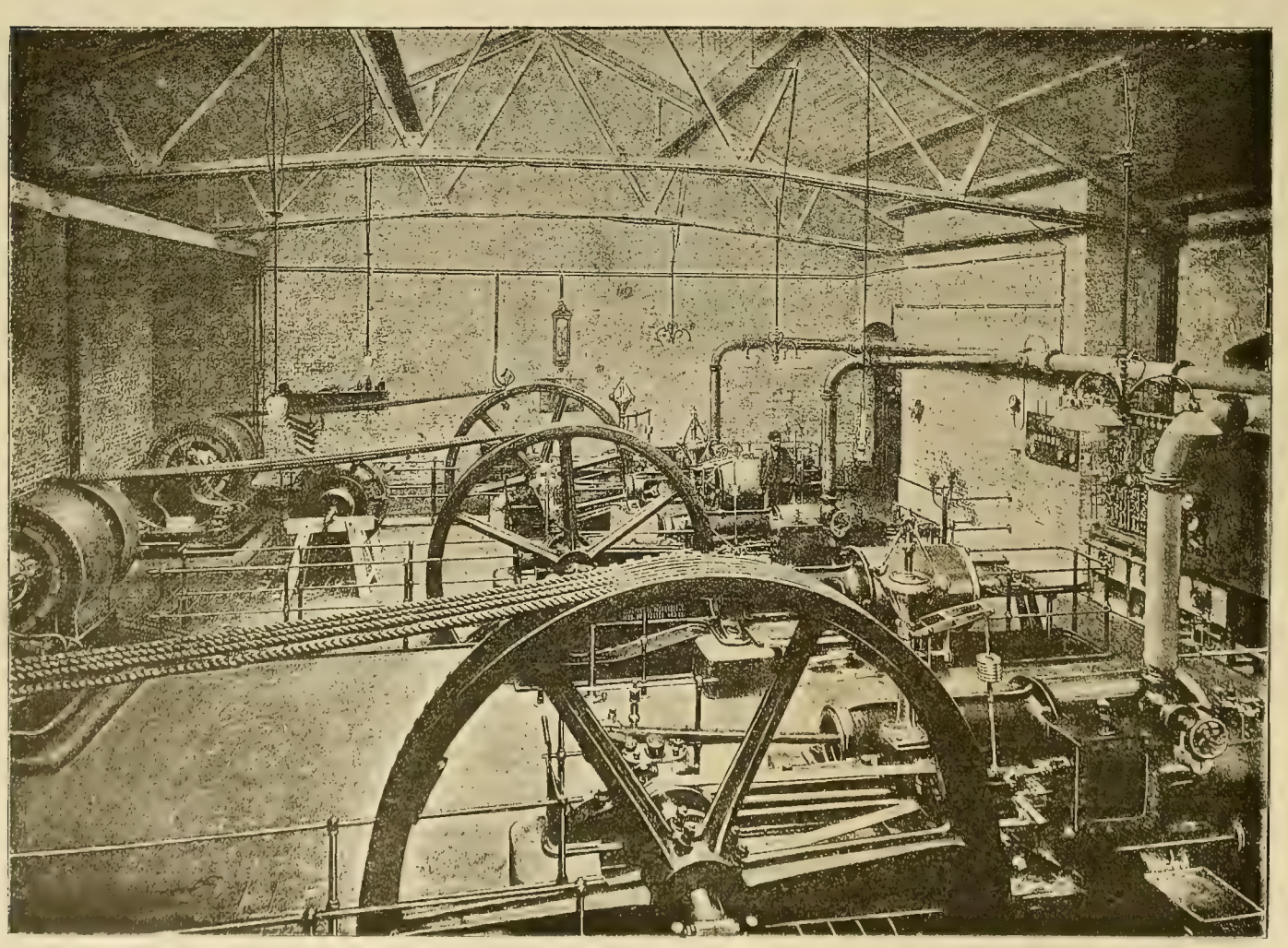


FIG. 4. ELECTRIC STREET CARS IN BUDA PESTH, HUNGARY.

connects with a crank-wheel on the platform. The operator is thus given an easy means of regulating the speed or reversing the movement of the car. For protecting the armature in starting four resistance coils are provided. These are placed under the platform of the car and are operated by a switch from either of the two platforms. The current is transmitted to the motor through a double sliding contact fastened to the truck of the car and reaching down through the slot between the rails of the conduit.

The power house, Fig. 4, which is located on Hartnergazze, has in it four boilers, each of 100 square meters heating surface. Three horizontal compound engines of 100 horse-power each drive three dynamos of the latest Siemens & Halske pattern. The generators are each roped to one

FIG. 5. ELECTRIC STREET CARS IN BUDA PESTH, HUNGARY.

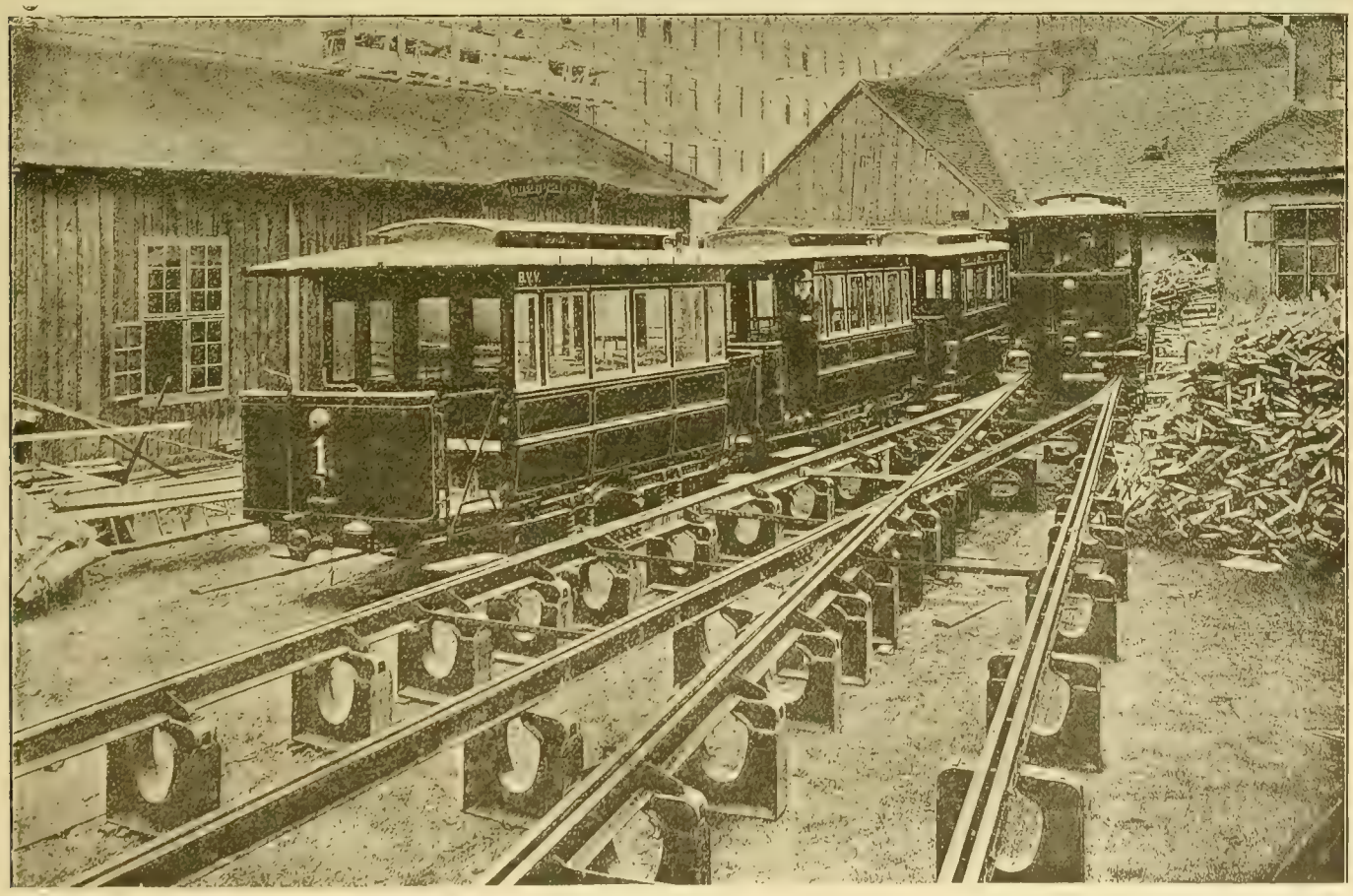


FIG. 2. ELECTRIC STREET CARS IN BUDA PESTH, HUNGARY.

of the engines. The current from the dynamo is carried to a switch-board furnished with the latest and most improved instruments for measurement, regulation and protection. The main feeders for the line are made of heavy lead encased cables with iron wire sheathing. Three sets of these feeders are carried to three different points in the system and terminate in distributing boxes. From these centers of distribution smaller cables are extended and are connected at numerous points to the iron conductors in the conduit.

At each terminal of the main line a repair shop is provided to facilitate the inspection of the cars after each trip. Power for the machinery in the shop is taken directly from the street service.

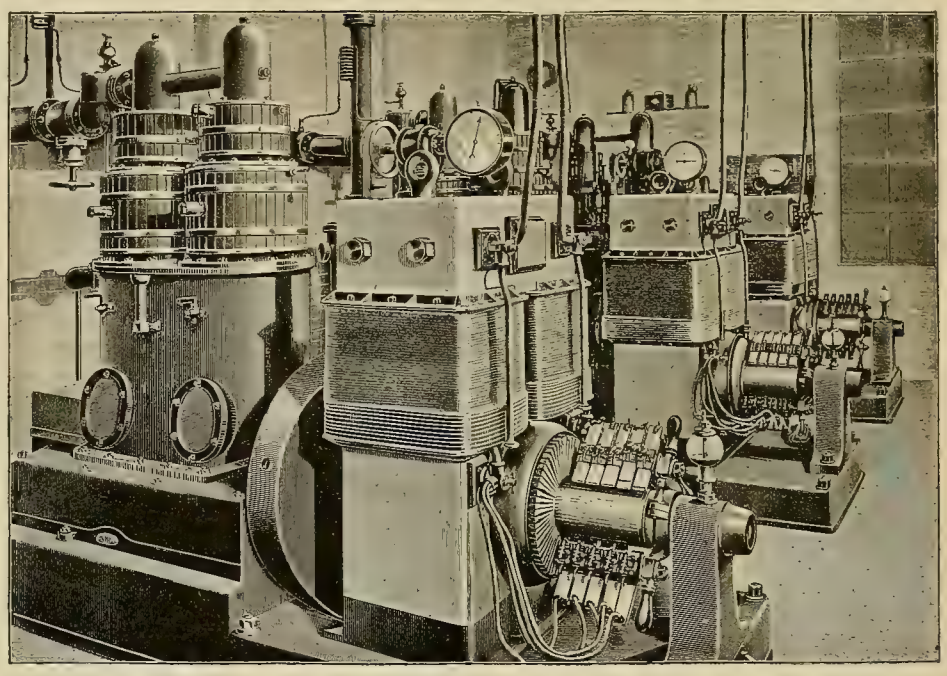
The rolling stock of the Buda Pesth line consists of fifty motor cars and eight trailers. The average speed is about nine miles an hour.

The present plant was started in 1889, but it has been extended from time to time until it now comprises six different lines, taking in most of the principal streets of the beautiful metropolis of Hungary. It is said that the equipment has from the beginning given satisfaction. The cuts are reproduced from the *Elektrotechnische Zeitschrift.*

An English Electric Light Plant.

A view of the engine room of the electric light installation of Maple & Co., at the Tottenham Court-road establishment, London, is shown herewith. There are three Willans & Robinson engines, each of which is coupled direct to a Castle dynamo built by J. H. Holmes & Co., of Newcastle-on-Tyne and London. Each dynamo is compound wound, and develops a current of 340 amperes at 112 volts when running at 450 revolutions per minute. The field magnet cores are large soft iron forgings, which were shaped on a planer. The brushes are formed of copper wire gauze. A lubricating compound is placed in the brushes. A tachometer is fitted upon each engine.

Steam for this plant is provided from three 30-horse power locomotive boilers. Feed water is supplied by a Worthington pump. Maignen's anti-calcaire system of water purification is used. The engine-room itself is about 28 feet long by 18 feet wide, and the walls are of white glazed bricks. There is still room for a fourth dynamo and engine to be installed. The ceiling is of channel iron, and the floor above is of concrete. The fitting and wiring of the lamps was carried out by Maple & Co. themselves. In the engine room are nine 16-candle power 110 volt lamps. The lamps in use are the Edison-Swan 16 candle power type, and the total number throughout the various shops and buildings is 2,400. The outdoor lighting is effected by means of ten arc lights, and these are supplied with current from an old machine of the Maxim-Weston type. The illustration is from the London *Electrical Plant.*



AN ENGLISH ELECTRIC LIGHT PLANT.

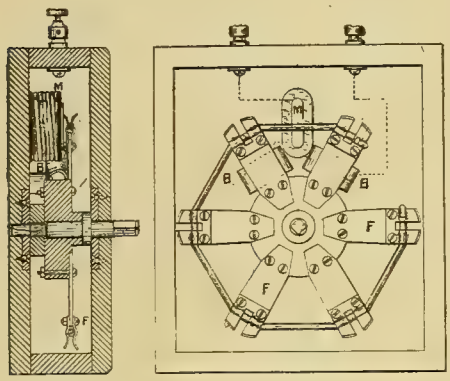
Legislation Affecting Telegraph Companies in Illinois.

A bill has been introduced in the Illinois legislature requiring telegraph companies in the state to make an annual report to the auditor on or before January 15th, giving under oath the number of miles of wire operated and the amount of gross receipts from all sources received within the state for the year. Companies are prohibited from doing business unless they file such report and procure a license from the auditor, the latter to be issued only on prepayment of two per cent. on gross earnings for the previous year. Violations of the provisions of the bill are punishable by a fine of $100 to $1,000 for each offense.

FIG. 6. ELECTRIC STREET CARS IN BUDA PESTH, HUNGARY.

Fuse Box.

This simple little device was designed as a means by which the troubles incident to the insertion of fuses might, to a great extent, be obviated. It will be seen from the cut that a length of fuse wire is held between spring clips *F F* arranged radially so as to permit of por-

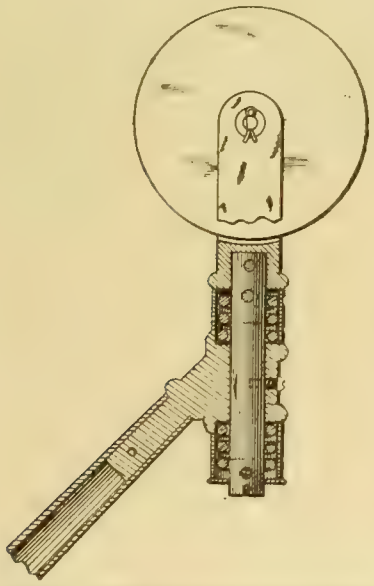


FUSE BOX.

tions of the wire being brought in succession into such a position that each portion will in turn make an electrical connection between two fixed contacts *B B*. In other words, when the fuse wire is in place and a pair of the clips are brought into connection with the stationary contacts the portion of the fuse wire between the clips will be in circuit. It is only necessary to move the fuse carrier by means of a key so as to bring the next pair of clips into connection with the stationary contacts, in order to throw a new section of fuse into circuit. An electro magnet *M* connected in the main circuit is so located as to present its pole to that part of the fuse which is in circuit. This magnet serves to rupture the arc that is formed upon the blowing of the fuse. This fuse box is the invention of A. W. Jones of Boston, Mass.

Flexible Connection for Trolley Wheels.

The device shown in the cut was designed by Alex. Palmros of Lynn, Mass., with the object of providing a connection between the trolley wheel and pole of an electric car, which would adjust itself automatically to the conductor.



FLEXIBLE CONNECTION FOR TROLLEY WHEELS.

The connection consists essentially of a loosely journaled spindle carrying the wheel and a pair of opposing coiled springs arranged as shown. The springs are wound in opposite directions—that is, one is wound to the right and the other to the left, for the purpose of automatically returning the trolley wheel and spindle, to the normal central position as soon as the wheel strikes a straight section of the overhead wire. The springs not only serve for the purpose of holding the spindle with a yielding pressure in its normal central position, but they, at the same time, allow the trolley to adjust itself automatically to curves and inclines on the wire.

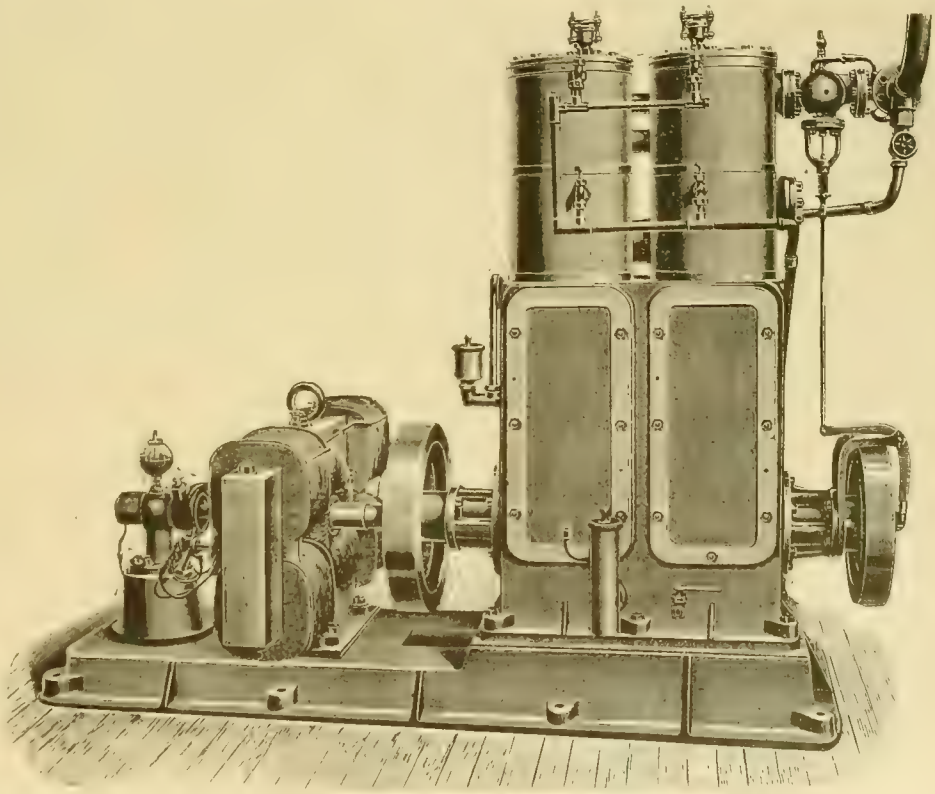
Long Distance Telephony.

It is announced that the German and Austrian governments have arrived at an understanding regarding the institution of a telephone service between Berlin and Vienna this year. Berlin is already connected as far as the town of Zittau on German territory, and in order to complete the proposed Berlin-Vienna line it will only be necessary to extend the service from Zittau to Reichenberg, and from Reichenberg to Vienna, via Prague. In Belgium the large commercial and financial firms are asking whether it would not be advisable to establish telephonic communication between Ostend and London by means of a submarine cable from the former to Dover and from the latter town to London by a land line. The post and telegraph department is already considering the question, but before any definite action is taken the working of the Paris-London line will be closely watched, so that the Belgians may profit by the experience which will accrue through the operation of this service. It is proposed either to ask the English and French governments to grant permission for a trial to be made to speak from Brussels to London, via Paris, or to allow a supplementary circuit to be joined to the Calais-Dover cable, while Brussels would be connected with Calais by an overhead line, or to lay a cable from Dover either to Ostend, Nieuport, or to La Panne. Four towns are particularly interested in the provision of direct communication with London. These are Antwerp, Ghent, Verviers, and lastly Brussels. It is estimated by the Belgian post and telegraph department that the cost of establishing the service could be covered.

If the proposed Brussels-London line be successfully carried out, a telephonic service is projected between Holland and Belgium. This would place Antwerp in direct communication with Rotterdam and Amsterdam, and Amsterdam with Paris via Brussels. Some years ago the erection of an overhead line between Verviers and Aix-la-Chapelle was commenced, but it was not completed.

The Crompton-Chandler Combined Engine and Dynamo.

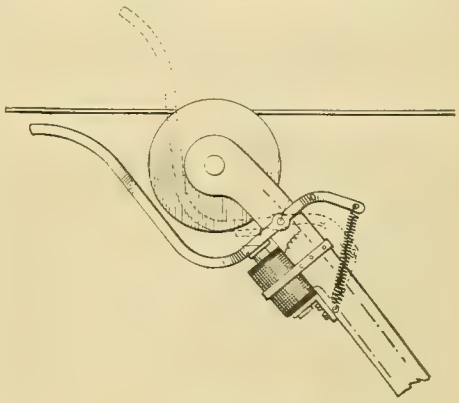
The illustration shows a double crank compound engine of the Chandler type driving a Crompton direct current dynamo. The engine is of 6½ horse-power and runs at 500 revolutions per minute. The dynamo has a ring armature of the type which Messrs. Crompton of England have used with much success. The armature is 15½ inches in diameter and 5 inches in face; the thickness of the core is 3 inches. The armature core is built up of thin disks on a cast spider. The maximum rise of temperature in this dynamo after a six hours' run is said to be 30° Fahrenheit. The output is 100 amperes at 55 volts. The total weight of engine, dynamo and bed-plate complete is 22 cwt. This type is being largely introduced for ship-lighting. The machine shown in the illustration is one of several sets to be sent to Australia. The cut was reproduced from London *Industries*.



CROMPTON-CHANDLER COMBINED ENGINE AND DYNAMO.

Another Trolley Catcher.

In a previous issue of the WESTERN ELECTRICIAN there was described an ingenious device for controlling the movement of the trolley arm on an electric car when the wheel had slipped off the wire. While the trolley catcher illustrated herewith is, perhaps, lacking in practicability, the idea embodied in it is sufficiently novel to merit mention. The object of the inventor, W. E. Jackson, Jr., of Augusta, Ga., was to provide a simple mechanism which would prevent the displacement of the wheel from the wire, or, if the trolley wheel should by any chance leave the



TROLLEY CATCHER.

wire, to guide it immediately back into place.

An inspection of the cut will enable the reader to understand the construction and operation of the catcher: A forked guide made of insulating material is hinged to the trolley-pole and an electro-magnet is fixed below it, as shown. Springs attached to the guide tend to throw it up so that its two prongs will embrace the wheel and wire. The electro-magnet is of high resistance and is strapped to the pole immediately below an armature fastened to the guide. The magnet is arranged in a shunt circuit from the main line in the same manner that the car lamps are usually connected.

When the trolley wheel is in contact with the wire the current will be shunted through the magnet, which will, it is claimed, pull down the guide. The instant the trolley wheel leaves the wire, however, the circuit will be broken, and the spring, pulling downward upon the forward end of the guide, will throw it into the position indicated by the dotted lines. The arms will now straddle the wire and serve to guide the wheel back into place.

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W. A. KREIDLER, - - - - - - - - - Editor and Publisher.
J. B. O'HARA, - - - - - - - - - - } Associate Editors.
F. L. PERRY, - - - - - - - - - - - }
W. E. KEILY, - - - - - - - - - - }

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.

W. H. TEMPLE, Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

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THE WESTERN ELECTRICIAN is enabled to present this week reproductions of the architect's drawings for the proposed electrical building of the World's Columbian Exposition. A description of the structure, as at present contemplated, was furnished by the architects, and will no doubt be read with interest. It is to be regretted that these plans were not made with a view of providing for a larger building, but it is a source of gratification that they may be changed so as to provide for more space and still retain the same general effect.

This should have been done when the WESTERN ELECTRICIAN first called attention to the fact that the proposed building would not provide sufficient room for all the electrical exhibits. The construction department, however, insisted that the original plans should be completed, and much time has therefore been wasted.

During the last week the question of securing additional space for the electrical display was carefully considered by Director-General Davis, Chief Barrett of the Electrical Department presented the matter to the director-general and is now preparing a formal petition which General Davis will present the board of directors.

The correspondence which passed between Chiefs Barrett and Burnham before communication between the departments was terminated by Chief Burnham, was also laid before the director-general, and he appeared favorably disposed to the propositions made by Chief Barrett. General Davis agreed that the electrical display ought not to be divided. He believed it should be the finest exhibition at the fair, and pledged himself to give the electrical people all the assistance in his power to make their department representative of the great advancement that has been made.

Chief Barrett was well pleased with the result of his conference with the director-general. It is believed that the claims of the electrical people will be recogized by General Davis and the Board of Directors, who have already given assurance of their confidence in Prof Barrett.

In the meantime, Chief Burnham is continuing his operations on the supposition that the original plans will not be changed. Work on the buildings and grounds is progressing, and the construction department expects to receive propositions for the electrical building at an early day. Mr. Burnham himself admits that a change in the location of the building would seriously affect the whole exposition, and might even jeopard the success of the fair. In view of this it is certainly to be wondered that he did not take steps in time to learn what the department would require.

Chief Burnham has had ample time to correct the error committed in the original plans, but he has seen fit to oppose his judgment to that of the entire electrical fraternity and all others who have looked into the merits of the case. In view of these facts, the responsibility should rest with the construction department, and the Board of Directors should insist upon Mr. Burnham providing a larger building for the electrical department.

THE Michigan legislature seems to be devoting most of its attention to electrical matters. Telephone and telegraph bills have been reported, and numerous measures referring to electric light and railway matters have been presented.

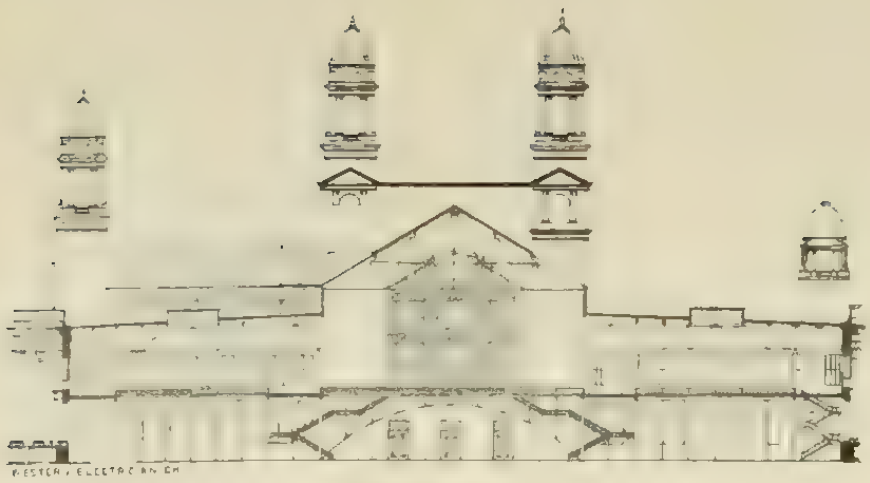
AT the last meeting of the Chicago Electric club Thos. G. Grier read a paper on "The Incandescent Lamp." Mr. Grier dwelt particularly upon the question of efficiency in lamps and its commercial significance. The paper, which is presented in this issue, provoked an interesting discussion.

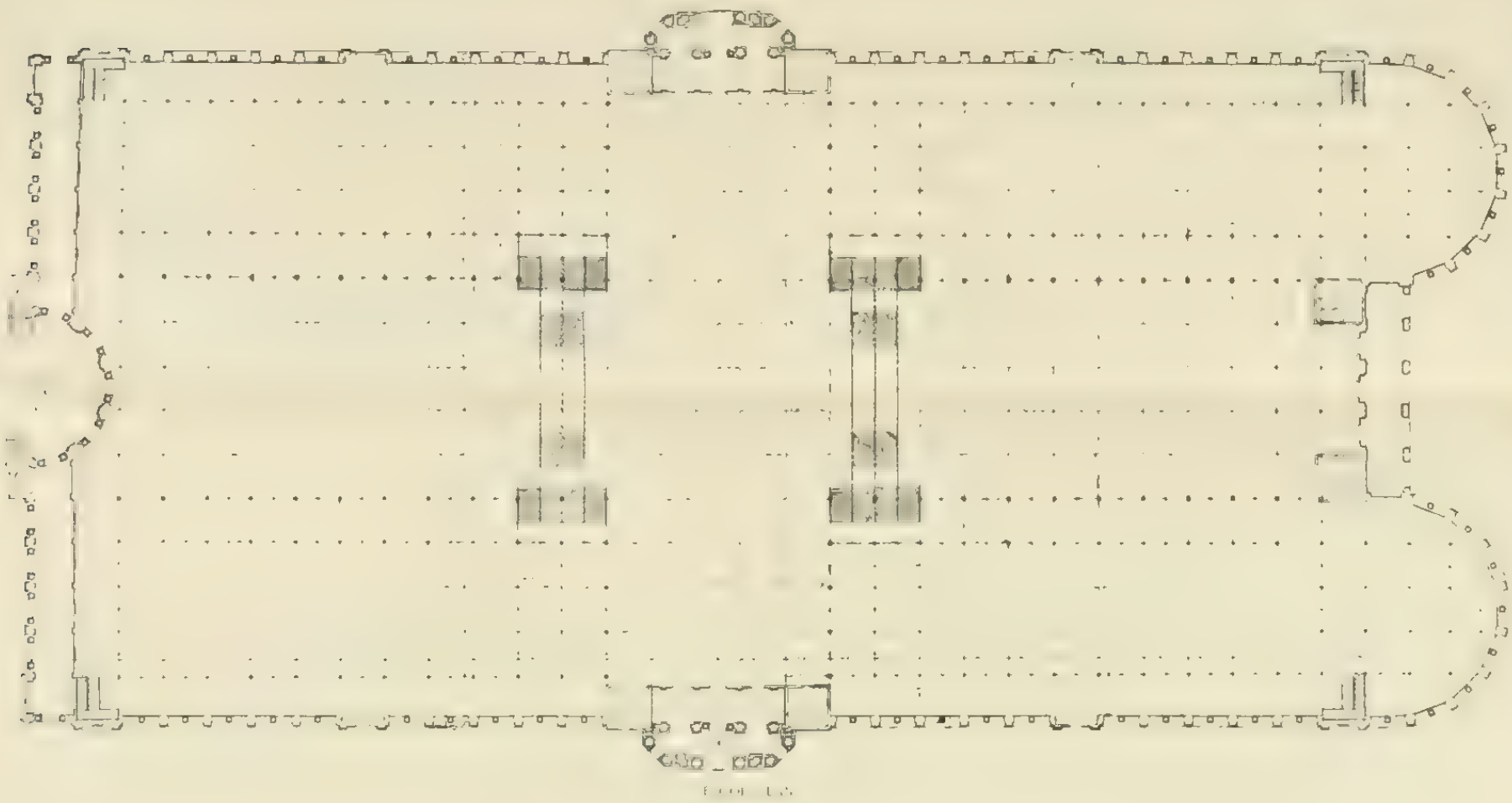
IT will be of interest to electric light men to know that the city electrician of Oakland, Cal., recommended that electric wires be strung on poles, and not buried. He does not believe that underground construction has reached the point where the city would be justified in compelling companies to place their wires in conduits.

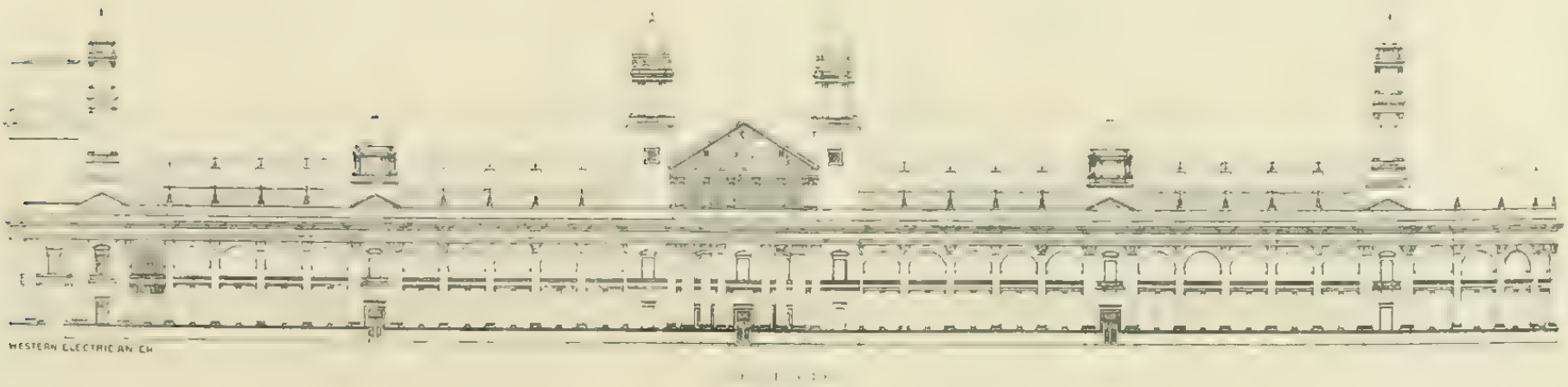
WITH this issue the WESTERN ELECTRICIAN takes pleasure in presenting a supplementary sheet of drawings showing the proposed electrical building for the World's Columbian Exposition. This is a harmonious and graceful structure, and the architects, who are in no way responsible for the unfortunate error in relation to its size, have reason to be proud of their work. Moreover, it is stated on their behalf that the building can be enlarged without interfering with the unity of the design, if ground space for such an extension is provided. We think that we voice the sentiment of the electrical fraternity in saying that the design itself is all that could be desired. Undoubtedly some means will be found to meet the just demands of the Department of Electricity. The supplement will no doubt be found convenient for future reference.

THE fact that the Thiele bill regulating telephone charges in Illinois is unlikely to become a law will occasion no regret. As is well said by the majority report of the legislative subcommittee to which the proposed law was referred, it would be certainly unwise, if not unjust, to require the telephone companies to cut down their tolls at a time when they are spending large sums of money improving their service to the public. The statement frequently made by the telephone men to the effect that the average business man would rather pay a little more rent for his telephone service and have satisfactory service is undoubtedly true to a great extent. It is probable that within a year or two telephone rates will be low enough to meet the ideas of the advocates of the bill. When that time comes the Bell companies must rely on the claim of a superior service that competitors can only hope to equal after the expenditure of much time and money. In the meantime it would hardly be worth while for the public to insist on a reduction that would surely result in poor service during the period of the metamorphosis.

THE American electrical engineer is apparently falling behind his European competitors. In quite a number of cases where improvement has been very marked, Americans have come in second. The cry has been, on this side of the water, that high tension alternating currents could not be successfully distributed through an underground system. Perhaps there was a method in the complaint, and our failure to undertake the solution of the problem was due to the attractiveness of overhead onstruction. Nevertheless we now find that London has taken Chicago's place and Ferranti is the man under whom we must study the alternating current underground service. Again it is difficult to reconcile one's self to the fact that it was not until England had commenced to operate an electric locomotive without gearing that Americans came into the field with the armature-on-the-axle equipment. To-day, in addition to all this, we find the German engineers leading the way in another field of electrical development. With all our talk about being the pioneers in successful underground construction, we may after all find that Germany is stealing our laurels obtained through the phenomenal exploiture of the electric street railway system. Photographic reproductions presented in this issue remind us most forcibly that there is one engineer, at least, who has made a noble effort to solve the problem of supplying the electric street car with current through a complete underground system. At Buda Pesth, Hungary, Siemons & Halske of Berlin have equipped quite an extensive system, and the service is through conductors placed below the track level. Unfortunately our contemporary to whom we are indebted for the description of the installation, failed to give much data which would have been of the greatest interest to the American reader. A fair idea, however, of the extent to which the work has been carried on, will be obtained from the illustrations. It may not be out of place to remind the reader that the climate of Buda Pesth is very dry, and that the line is operated at 300 volts. This should be taken into consideration in connection with the fact that the demands on the line are not excessive as there is no concentration of business into one particular quarter of the city, like in Chicago or other American cities.







PROPOSED ELECTRICAL BUILDING AT THE WORLD'S FAIR, CHICAGO.

Proposed Electrical Building at the World's Fair.

The readers of the WESTERN ELECTRICIAN will be able to gain an excellent idea of the proposed electrical building at the World's Columbian Exposition by referring to the four views of the structure presented in the supplement accompanying this number. The illustrations are made from the architects' tracings, and can be depended upon as an exact representation of the design made under the authority of the construction department. Of course, if the Department of Electricity is successful in its demands, the structure will be considerably enlarged or else used for some other purpose than for containing the electrical exhibit. The architects are Van Brunt & Howe of Boston and Kansas City, and it is hardly necessary to say that they are in no way responsible for the dimensions. They say that the building could be enlarged without altering the general design. The following description of the building was written especially for the WESTERN ELECTRICIAN by the architects:

"The electrical building occupies an area 350 feet 11½ inches in extreme width and 766 feet 7¾ inches in extreme length; the area covered by the building is 211,190 square feet, or 4 85 acres, the major axis running north and south. The south front is on the great quadrangle or court; the north front faces the lagoon; the west front is opposite the manufacturers' building, and the east faces the mines building.

"The general scheme of the plan is based upon a longitudinal nave 115 feet wide and 114 feet high, crossed in the middle by a transept of the same width and height. The nave and the transept have a pitched roof with a range of skylights at the bottom of the pitch and clear story windows. The rest of the building is covered with a flat roof, averaging 62 feet in height and provided with skylights.

"The second story is composed of a series of galleries connected across the nave by two bridges, with access by four grand staircases. There are subordinate staircases in the four corners of the building. The area of the galleries in the second story, as at present arranged, is 118,542 square feet, or 2.7 acres, but there is capacity for an extension of this area, if necessary.

"The exterior walls of this building are composed of a continuous Corinthian order of pilasters, 3 feet 6 inches wide and 42 feet high, supporting a full entablature, and resting upon a stylobate 8 feet 6 inches high. Above is an attic story 8 feet high, the total height of the walls from the grade outside being 68 feet 6 inches. This order is divided into bays 23 feet wide, this dimension serving as the module of proportion for the plan of the whole building.

"In the center of each of the four sides is an entrance pavilion, against which the higher roof of the nave or transept abuts.

"The north pavilion is placed between the two great apsidal or semi-circular projections of the building; it is flanked by two towers 195 feet high. The central feature is a great semi-circular window, above which, 102 feet from the grade, is a colonnade forming an open loggia or gallery, commanding a view over the lagoon and all the north parts of the grounds. Access to the loggia is obtained by elevators.

"The east and west central pavilions are composed of two towers, 168 feet 6 inches high, between which the transept roof finishes in a gable or pediment with a row of windows beneath, giving light to the transept. In front of these two pavilions there is a great portico composed of the Corinthian order with full columns. Within this portico is an inner porch, forming a vestibule in each case.

"The south pavilion is a hemicycle or niche, 78 feet in diameter and 103 feet high. This niche is covered by a half dome with ribs and decorations in relief, the Corinthian order being carried round the walls of the niche. The opening of this niche is framed by a semi-circular arch, the impost of which is supported by four full Corinthian columns continuous with the order of the facades. This arch is crowned by a gable or pediment with smaller gables on the returns, and surmounted by an attic, the whole reaching the height of 142 feet. In the center of this niche, upon a lofty pedestal, is a colossal statue of Franklin, whose illustrious name intimately connects the early history of the republic with one of the most important discoveries made in the phenomena of electricity. In order to carry out this idea, on the frieze of the great order around the niche appears the Latin inscription, 'Eripuit cœlo fulmen sceptrumque tyrannis.'

"At each of the four corners of the building there is a pavilion, above which rises a light open spire or tower, 169 feet high. Intermediate between these corner pavilions and the central pavilions on the east and west sides, there is a subordinate pavilion bearing a low, square dome upon an open lantern. There are thus ten spires and four domes, which combine to give to the otherwise rigid horizontal lines of the building an effect of lightness and animation in accord, it is hoped, with the purposes of the building. All these towers are composed of one or more orders of architecture with open arches, interior domes and balustrades. The entablature of the great Corinthian order breaks around each of the pilasters of the four fronts, and above each pilaster in the attic order is a pedestal bearing a lofty mast for the display of banners by day and electric lights by night. Of these masts there will be in all fifty-four.

"The first story of the building is indicated in these facades between the great pilasters of the Corinthian order, by a subordinate Ionic order, with full columns and pilasters, forming an open screen in front of the windows of this story. Above this Ionic order is an order of arches in front of the windows of the second story. This Ionic order is converted into an arcade where it passes in front of the north pavilion, forming there an open portico with a wide balcony above looking toward the lagoon. All this exterior ordonnance is carried out strictly according to the formulas of the Italian renaissance, all the architects employed upon the buildings forming the great quadrangle or square having agreed to use a strictly scholastic form of architectural expression, similar in respect to the height of the order, but varying in regard to its character and distribution. In this way, by frequent comparison of designs, they have endeavored to obtain for the quadrangle, which is the main architectural feature of the exposition, a unity of feeling, recalling in scale and character the most dignified and important manifestations of architecture obtained in the baths and forums of classic times.

"According to agreement among the architects of the buildings around the quadrangle, the electricity building will, like the rest, have an open portico extending along the whole of the south facade, the lower or Ionic order forming an open screen in front of it. The various subordinate pavilions are treated with windows and balconies. The details of the exterior orders are richly decorated, and the pediments, friezes, panels and spandrils will receive a decoration of figures in relief, with architectural motifs, the general tendency of which will be to illustrate the purposes of the building. It is intended that the friezes of the Ionic order shall bear in each bay the name of a discoverer or inventor associated with the development of the science of electricity, thus setting forth a biographical history of the science.

"The color of the exterior will be like marble, but the walls of the hemicycle and of the various porticos and loggia will be highly enriched with color, the pilasters in these places being decorated with scagliola and the capitals with metallic effects in bronze.

"In the design of this building it is proposed by the architects to so devise its details and general outlines that they may be capable of providing an electric illumination by night on a scale hitherto unknown, the flag-staffs, the open porticos, and the towers, especially, being arranged with this in view. It is proposed that the hemicycle or niche which forms the south porch shall have either a great chandelier or crown of lights suspended from the center of the half dome, or shall be provided with electric lights masked behind the triumphal arch which forms the opening of the niche."

The WESTERN ELECTRICIAN is indebted to the architects and to Messrs. Graham, Kenyon and Cloyes for assistance in procuring the drawings and description of the building.

Chicago Electric Club.

The annual election of officers of the Chicago Electric club was held Thursday, April 16th, between 5 and 7 o'clock. Considerable interest was manifested, and there was a spirited canvass for several offices. There were a large number of candidates, and four printed tickets were circulated. When the votes were counted it was found that the following named gentlemen had been selected for the offices named: President, B. E. Sunny; first vice-president, F. B. Badt; second vice-president, Alex. Kempt; third vice-president, D. P. Perry; fourth vice-president, George C. Bailey; secretary, W. A. Kreidler; treasurer, F. S. Terry; managers, F. E. Degenhardt, chairman, J. P. Barrett, E. Baggot, W. B. Pearson, F. W. Parker, M. A. Knapp, C. H. Wilmerding, F. G. Beach, E. R. Gilman, W. H. McKinlock; membership, C. C. Haskins, George Cutter, G A. E. Kohler.

When the result was announced the selection was made unanimous upon motion of F. W. Cushing. A vote of thanks was extended the retiring president. President Sunny was called upon and in responding gracefully thanked the members for the honor conferred upon him. Speaking of the outlook for the club, he said:

A few suggestions as to what the club has accomplished during the past, and its expectations as to the future, may not be out of place at this time.

That the movement which resulted in the organization of the Electric club was a wise and good one, every one is convinced. From an undertaking that struggled for existence for a great many months, it has developed into a permanent and stable institution, and has accomplished more for the good of its members and for the enlightenment of those engaged in the electrical business than we are apt to realize from a casual examination.

From this club have gone out all over the world some of the most carefully prepared and interesting papers that have been presented to the electrical fraternity, and that they have been read with much interest and have excited wide-spread discussion and comment is evidenced from the pages of the several electrical journals.

We who are in Chicago and have all of the advantages of close connection with the innumerable sources of information do not appreciate the full value of papers brought out by the club, and the discussions suggested by them. We do not realize how eagerly these papers and the discussions that result from them, when published in the electrical journals, are sought after by the many men employed in the various smaller cities all over the country. These men are almost dependent upon the work of such institutions as the Electric club for enlightenment on the condition and improvements made in electrical development, and there is no question but that they value very highly the services that the Electric club have rendered them in this respect.

Not only have the workers all over the country been benefited and assisted through these papers and the discussions that have followed their reading, but the information brought out has been an inspiration and a help to the investigators and inventors

Nor do the benefits conferred by the club stop here. One of the greatest advantages that the club holds out to its members, and one that is overlooked to a very large extent is that it enables every member to put before an interested, expectant community of electricians any views that his experience and research may have given him on any of the important subjects that are the source of so much discussion and conjecture. The platform of the Electric club is free to any of its members, and the labor in getting together the material for a paper is fully rewarded by the wide advertisement that the compiler gets from the publication of his effort in the several journals.

I have in mind a number of ambitious and energetic young men who have acquired practically a national reputation in electrical matters, as engineers and electricians, and who owe it all to the advertisement that they have received on account of papers written by them, or of the part that they have taken in the discussions on the important topics that have been up for consideration. This is an important matter for every man employed in the electrical business, who is anxious to advance his own special part of the work, and himself personally.

When he writes a paper and publishes it to the world, he puts himself in the position of an educator, and if his ideas are good and his logic reasonably strong, he immediately acquires a following that will broaden out as he persists in the work, in connection with which so many desire advice and assistance.

The interest in the club's affairs by its members was never greater than at present, which was fully evidenced in the election to-day, when there were three or more tickets in the field. It is a healthy sign in the affairs of a club when the members will not permit one set of nominees to be elected, but take the matter in their own hands, and select for the officers of the club persons in whom they have most confidence. If the members were indifferent to the welfare and prosperity of the club, they could not show it in a more potent way than by taking no interest in the election and permitting any ticket suggested to be elected.

The growth of the club has been constant and very satisfactory. Its membership now is strong, is made up of progressive and enterprising men, and there is every reason to look for an increase in the membership during the next two years, that will place it among the substantial organizations of the country.

The only problem that the club has had to cope with is

with reference to the restaurant service, which is a source of trouble and annoyance in every club, without reference to size. During the past two years we have had a valuable experience in this matter, which has cost considerable money, but at the same time has been acquired at a less sum than it has cost a great many institutions of similar character.

The expectation is now that a lunch can be served in the middle of the day, consisting of cold meats, hot tea and coffee, with the usual accessories, and at a moderate cost, to members, on a basis that will make that department of the club self sustaining. A restaurant service contemplating an extended bill of fare is not only out of the reach of

THE ECONOMIC LAMP.

this club, but is an undertaking that has met with a loss in some of the strongest clubs in the city.

As our membership increases, the restaurant service may be increased. One of the commercial clubs in Omaha, having a membership of 400, with dues of $50, is able to make expenses, and at the same time furnish an extended bill of fare. With our membership at half that number, it is safe to begin at the point that we have in mind, and gradually expand until we get to the point reached by our Omaha friends.

There is no doubt but that our present quarters will be outgrown before that time comes around, and that it will be absolutely necessary to get new quarters. Some work has been done in this direction already, and it is the expectation that the next move made by the club, a year hence, will be into quarters that will be the home of the club for the next five years. In 1893 the ability and capacity of the club will be taxed to its utmost in the reception and entertainment of distinguished visitors from all over the world. Its plans for a home, therefore, must be on a broad and generous basis, but at the same time entirely within its means.

The club is bound to be an important factor in connection with the World's Columbian Exposition. It has already been of great service to the World's Fair authorities in furnishing information for their guidance regarding the electrical feature of the proposed exhibition. Unfortunately the club's services were not called upon at a date sufficiently early to avoid some mistakes having been made, but it is our hope and expectation that the club will be able to have the mistakes rectified, and that it will be able to claim a substantial share of the thanks that will be due from the electric fraternity for an exhibition in 1893 that will be unparalleled in the history of electrical affairs, and be complete as indicating the exact condition of the art.

The finances of the club are in the main in a satisfactory condition. Our assets and liabilities about balance each other We start out the new year free from the enormous tax levied last year, and if we can carry out our expectation of making the restaurant service self-sustaining, we ought to show a balance to our credit at the end of the year of not less than $2 000.

This undertaking does not seem to be impossible of accomplishment, but the managers of the club will have to depend, as they always have, on the members for hearty co-operation and assistance, which undoubtedly will be forthcoming, as it always has been.

Other officers were called upon and they made brief remarks. The election was one of the most interesting events in the history of the organization. Seventy-five members attended, and as only members who had paid up their dues were permitted to vote, the club's treasury was greatly benefited, $500 being received during the week prior to the meeting.

New Interior Conduits.

The Interior Conduit & Insulation company has introduced a new form of interior conduit illustrated in the accompanying cuts. Fig. 1 illustrates the metal covered tube. The interior tube is drawn through a die and an outer covering of either brass, steel or iron drawn upon it, fastened and securely sealed, by an ingenious lapping of the seam. The tubes are joined together by screw couplings. In order to guard against any liability of moisture or condensation providing a leak to the outer covering of the tube, a pliable washer is inserted between the two abutting ends of the tube, as shown. Fig. 2 illustrates two separate tubes covered with one piece of metal drawn on in the same manner. This double tube will be made in sizes one-quarter and five-sixteenths inch inside diameter, and will be introduced as a substitute for moulding.

FIG. 1. NEW INTERIOR CONDUITS.

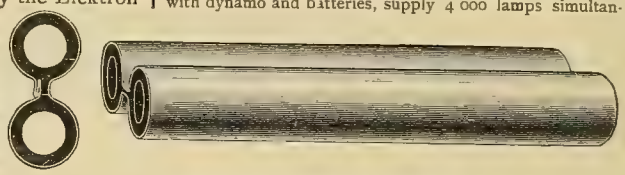
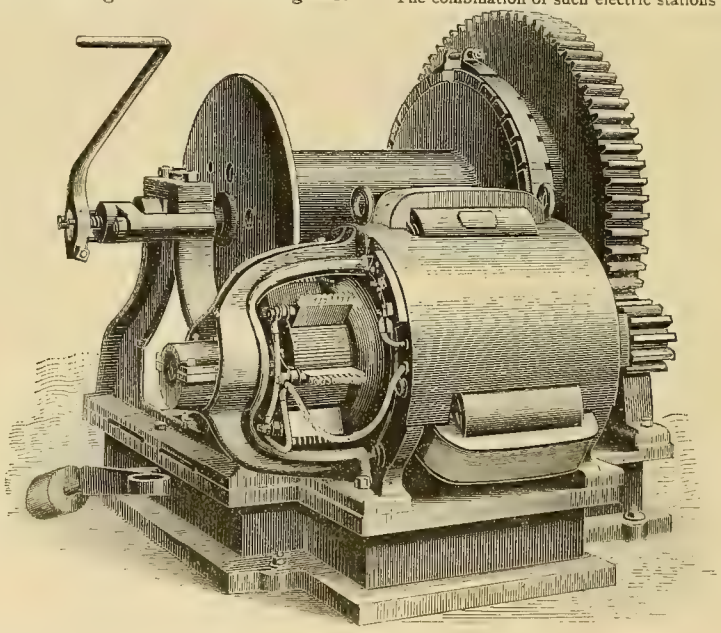


FIG. 2. NEW INTERIOR CONDUITS.

Perret Single Reduction Electric Hoist.

In the accompanying illustration is shown an electric dock hoist introduced by the Elektron Manufacturing company. In machinery of this character single reduction is particularly desirable, on account of the saving in space, noise and friction. The motor is a 15 horse power Perret multipolar, making 450 revolutions per minute, geared by a gun metal pinion to a 38-inch gear on the drum shaft of the hoist. The drum is one foot in diameter, giving a speed on the hoisting rope of a little over 200 feet per minute.

The motor is shunt wound, and drives the gear wheel at a constant speed, which may be increased, if desired, by introduction of resistance in the field circuit. By depressing the hand lever the hoisting drum is forced against a friction device revolving with the gear wheel and lifts the load, its speed varying with the pressure on the lever. To lower the load the foot lever is depressed, and the hand lever raised.



PERRET SINGLE REDUCTION ELECTRIC HOIST.

The Economic Lamp.

In the accompanying illustration is shown the Economic incandescent lamp which is being introduced to the western trade by the Northwestern Electrical Specialty company, 1017 Chamber of Commerce building, Chicago, of which George L. Kirkland is manager. This lamp is well-known in the East. The claims made for this lamp are full rated candle power, long life, absence of discoloration, nd comparatively little current consumed.

At the close of the year 1890 the Bengal Telephone company of Calcutta, operated 437 exchange and private lines.

Gas and Electric Lighting.

In its yearly report the German Continental Gas company states that it is continually endeavoring to increase the consumption of gas, not only for heating and power purposes, but also in decreasing the cost of installation. The construction of larger gas engines than those generally used has been already successfully commenced, and last year Zwilling gas engines of 140 effective horse-power were built on the Otto principle. When the central electrical light station of the company in Dessaw, was built in 1886, the largest gas motor in use was of 60 horse power but in 1889 the first gas engine of 100 horse power with four cylinders was constructed. Experience justifies the idea that the construction of gas engines is by no means confined to small motors, but that their use is constantly in the direction of engines of greater powers, since the consumption of gas per horse power diminishes as the engines are made of larger powers.

This progress is important for the production of the electric light in large centers: As one instance of this the company cites the fact that with the excellent results obtained from its accumulators—an efficiency of 78.9 per cent.—one Zwilling gas engine of 140 horse power can, with dynamo and batteries, supply 4 000 lamps simultaneously, these corresponding to about 5,000 16 candle power lamps installed. Thus, three motors of this power in a central station can supply 12,000 lamps or, say 15,000 connected. This number of lamps will at present suffice for all small or medium sized towns, and even for large cities where the first installation does not exceed 15,000 lamps. It is fair to assume that even gas engines of 140 horse power will not long remain the largest, as others to higher powers will probably be constructed, according of *Elektricitaets Zeitung*.

The combination of such electric stations with neighboring gas works not only reduces the operating expenses, but it has also the great advantage that the works can be erected in the center of the town, owing to the abolition of the smoke nuisance and danger of explosion; it requires less ground surface and less water, and reduces the length and therefore the expense of the electric light cables. The consumption of gas in the company's lighting district has steadily increased, notwithstanding the extension in the use of electrical illumination, the former business holding, as in previous years, the first place. The competition of petroleum has been slightly less, and even the use of this illuminant will, with large gasworks, be supplanted by the employment of regenerative lamps.

The Pasadena, Cal., *Star* says in reference to the proposed railroad to the top of Mount Wilson, that the road will probably be operated by electricity. It will extend from Altadena up Rubio canyon, and up the west side of Eaton canyon, terminating at a point near the present observatory. It will be twelve miles long, and will have a grade of about seven per cent. The electric plant will be located in Pasadena, and will furnish power for other purposes Six cars will be operated. The cost is estimated at $500 000.

Electrical Department of the World's Fair.

Since Director-General Davis of the World's Fair has returned from his trip to Florida, Chief Barrett of the Department of Electricity has had several conferences with him in relation to the great question now confronting the department, "Shall the electrical exhibit at the exposition be presented in such a manner as to permit an adequate and effective display?" The entire correspondence that has passed between Chief Barrett and Chief Burnham in relation to the size of the building and the division of the exhibits has been laid before General Davis, and the whole question has been thoroughly discussed from the standpoints of both departments.

The director-general has invariably received Prof. Barrett with cordiality and manifested the most friendly and appreciative spirit toward the electrical interests. He agreed with the chief of the electrical department when the latter pointed out that a division of the electrical exhibits would seriously interfere with the general effect of the display, and said that there ought not to be such a division if it could possibly be avoided.

General Davis was also free to admit that Prof. Barrett was the best judge of the space needed and the character of the exhibits in his own department. He asked the chief of the electrical department to prepare a written statement of his demand for more space, and promised to lay the matter before the board of directors, at the same time recommending that some relief be afforded.

An official request for the circular building known as the "machinery annex," and illustrated in the WESTERN ELECTRICIAN of April 11th, was presented to the director-general on behalf of the electrical department, and General Davis promised to give the matter his earnest attention.

The director-general also located the headquarters of the electrical department permanently in the present offices on the fifth floor of the Rand-McNally building, and the work of fitting them up comfortably for permanent occupancy will be begun at once.

Electricite, a leading electrical paper of Paris, has the following in its issue of April 4th: "The commission appointed by the French government to determine the extent and character of the French exhibit at the World's Fair at Chicago has expressed itself as favoring an extensive exhibit, giving as one reason the possible presence of a large number of visitors from South America. The trade of this section has largely been in the hands of France, and if she would not be outdone by the Americans she must present herself to the best advantage."

"Not the least interesting part of the great exhibition in Chicago next year," remarks the London *Electrical Engineer*, "will be the town itself, with its buildings ten, twelve, even eighteen and twenty stories high, its magnificent parks, drives, and boulevards."

The *St. Louis Globe-Democrat* says that the Unicycle Electric Elevated Railway company is "figuring on the erection of a five-mile track in Jackson Park, Chicago, to be used during the Columbian Exposition." This company has just completed a full-sized experimental railway in the building formerly occupied by the Real Estate Exchange on Seventh street, between Market and Chestnut streets, St. Louis. The track extends into the yard in the rear of the building, and curves about very abruptly at either end—forming a circuit—and contains two compound curves. It is equipped with a platform car sixteen feet in length, which is said to have made several successful trips.

Construction Department and the Electrical Building.

Elsewhere in this issue will be found reproductions of a complete set of drawings showing the interior and exterior features of the proposed electrical building at the World's Columbian Exposition. As the readers of the WESTERN ELECTRICIAN are well aware, this journal, in common with all the representatives of the electrical interest who have examined the subject, is convinced that the building is entirely inadequate to meet the needs of such a display as will properly represent the electrical industries of the world in 1893. Entertaining an honest belief in the justice of the cause—and it is not necessary to repeat the many and cogent reasons that lead to that belief—the WESTERN ELECTRICIAN has striven earnestly to aid the Department of Electricity in the effort it is now making to secure desired modifications of the proposed plans by which more space can be secured. The interests of the exposition demand that this endeavor, backed, as it is, by every consideration of justice, equity and good policy, succeed, and that, in the end, an amicable arrangement be made, whereby the electrical exhibit will have suitable quarters.

Meanwhile, the WESTERN ELECTRICIAN, desiring to present the case in a fair manner, has endeavored repeatedly to secure from Mr. Burnham a written statement, presenting his views on the subject. This he has refused to give. The department, however, seems greatly interested in everything pertaining to the electrical building. A representative of this paper last week talked with several gentlemen connected with the construction department. They were all glad to discuss the situation in a friendly spirit. Their views may be summarized as follows:

"We have none but the most friendly feelings for the electrical people, and will gladly meet any of them at any time and discuss the plans. We want to put up a building that the electricians can approve from their own standpoint, and we fully realize the fact that the construction department will be judged by the success of each part of the exposition as well as by the whole. But as it is, the building is much larger than any structure previously erected for the electrical department of a world's fair. It contains 60,000 feet of gallery space that you people appear to have left out of the calculation altogether. Then, too, an addition 50 feet wide might be made on the west side. This could contain all the engines and boilers for the steam plant, and perhaps some of the heavier machinery. With this addition, the building would contain about 340,000 feet of floor space, instead of 245,000, as the electrical people have figured it. It is difficult to see how the plans could be changed now. To make new plans would take three or four months and delay all the work of the fair. Possibly an addition can be made, but it could hardly be more than the 50 feet on the side. We have no authority to change the plans in any event. In the beginning we were told to lay out the buildings after studying the designs of preceding expositions and allowing liberally for the progress of the arts and sciences in the meantime. We asked the national commission and the board of directors for estimates for the various buildings, and were largely guided by their advice. Then the grounds and buildings committee approved the general design and estimates, and the work of making plans was begun. So you see that we worked largely under direction, and are bound so that we cannot now change the plans at will. No doubt all the buildings will be too small to hold all the exhibits offered. The chiefs of the various departments will have to prune down and exercise a wise discrimination. In regard to the division of the electrical exhibits, we simply have to take the official classification, adopted by the directors, as our guide. That provides that electric railways must be shown in the transportation department, electrical mining machinery in the mining department, and so on. Of course, we took this into consideration in laying out the building. Then again, the financial aspect of the question must be considered. We have estimated the cost of the electrical building at $350,000, and have figured down very close in order to get the most for the money. A larger building would cost more. That would mean another appropriation, and money is hard to get. We will gladly consider any way out of the dilemma, but we do not see any."

It will be observed that the construction department has so far advanced as to admit that there is a dilemma, and to offer to make a 50-foot addition. Undoubtedly it is only a question of time when the department will be brought to see that the other objections advanced by it are not insuperable.

Governmental Control of Electric Interests.

Those who have been longing for the absorption of the great electric interests of the country by the government should stop to reflect for a moment upon the experience of other countries which have foolishly allowed the government to supplant private capital. Complaining of the lack of enterprise displayed by the government in the telegraph and telephone service the London *Electrical Review* says: "It is always the same; we are absolutely without knowledge of a single instance of departmental reform from within, and are daily confronted with the fact that the only possible reforms—from without—have to be fought for inch by inch, in the face of the strongest opposition from the powers that rule. Who does not know that Rowland Hill encountered the greatest resistance from the postoffice employes before his reforms were adopted, or that when the electric telegraph was first brought to the notice of the government, officialism promptly dismissed its claims with the reply that a very good semaphore system existed in which they had all that they required. The state always has been and always will be a stumbling block in the way of industrial progress; even as regards the penny post itself, two centuries ago we should probably have had this, but for the interference of the government. The action of the government with reference to telephony is recent history, and none will deny that telephonic progress in this country has been hampered by officialism. Verily Mr. Raikes and M. Jules Roche may congratulate themselves on telephonic communication having been established between London and Paris, but had it not been for the action of the state, on this and on the other side of the channel, speaking between the English and French capitals would have been an accomplished fact six years ago. This important truth seems to have escaped the attention of all the journals which indulged in such a lively fanfare, but truth it is all the same, and while the achievement at last is due to the postoffice, at the doors of the same department lies the prohibition, which by its policy was placed on private enterprise."

Electric Lighting in Massachusetts.

There is considerable interesting matter in the argument of Everett W. Burdett, before the Massachusetts legislative committee on the municipal control of electric lighting. The facts he presents may open the eyes of those who advocate the socialistic principles now so popular. In the course of his argument he presented these facts:

"There are in active business to-day in Massachusetts sixty one companies engaged exclusively in the manufacture and sale of electric light and power. Invested in those companies is capital to the extent of $5,452,025, contributed by 2,300 stockholders.

"All this investment is in the stock of the corporations. There is also invested in the bonds of these companies, by other persons than the 2,300 I have referred to, $2,082,944, making a total investment in the stock and bonds of companies exclusively engaged in the electric light and power business in Massachusetts of $7,534 969. The estimated value of the electric lighting departments of gas companies is $1,193,538. This sum increases our total to $8,728,507. But that is not all. I add to those figures the sum of $305,000, the amount of the capital invested in two corporations under lease to another, which are not included in the returns of the latter, and which do not themselves make returns. They either have been or are about to be purchased by the company to which they have heretofore been leased. Adding their capital and bonds to the figures above given from the report of the gas and electric light commissioners we have a total investment in the electric lighting and power business of Massachusetts, on the 30th day of June, 1890, of $9,033,507.

"There should be added to the 2 300 electric light stockholders the number of stockholders in gas-light corporations in the Commonwealth, amounting to 4,725, making a total of 7,025 people whose investments are directly touched by the legislation which is proposed. Nor do these numbers include the employes of the companies, who are quite a considerable number. It is estimated that throughout the United States the number of persons employed by electric lighting companies is upward of 300,000. I think that in Boston alone there are about 3,000 persons directly dependent, as wage earners, upon the electric light and gas industries.

Says the London *Electrical Engineer*: "Along the docks cranes and hoists of all kind are now worked by hydraulic power. At every new work of this kind, new docks and new warehouses, our electrical engineers should keep a sharp lookout to interest the architects, engineers or government authorities in the utilization of electric motors. The scope in this direction is certainly not small, and might be perhaps combined with small electric tramways for transport of goods."

The Incandescent Lamp.[1]

By Thomas G. Grier.

Incandescent lighting is now merging into a second decade of commercial life, and any neglect on the part of the electrical fraternity to fully understand the importance which the incandescent lamp plays in this growing industry, is suicidal to their interests.

The subject is entirely too large to treat comprehensively in a limited article, but a few points will be brought forward that it is hoped, will promote discussion and bring forth valuable information from members of the club.

Though ten years have hardly passed since incandescent lighting has been an acknowledged possibility, the birth of the lamp has been recorded for nearly half a century. Platinum wire heated to incandescence seems to have been the earliest form of the incandescent lamp, and was experimented with even as recently as 1885. In 1845 we read of experiments with carbon sticks and pencils inclosed in glass globes, that were either filled with some non-active gas or had the air exhausted and the carbon surrounded by a vacuum.

The march of invention at last, in 1879, reached a point at which the public was assured that a new era of artificial illumination would be upon them, and so authoritative was this assurance that the gas stocks all over the country declined in value. It was not, however, until the year 1880 that any definite information as to the electrical properties of the incandescent lamp was determined, and in 1881 incandescent lighting was no longer a laboratory phenomena, but was merging into an industry, the proportions of which at the present day are hardly realized.

The Franklin Institute of Philadelphia, in view of the advance in the application of electrical science to commercial uses discussed the advisability of holding an electrical exhibit, and in the fall of 1884 the desire and anticipation of the members of the Institute were accomplished.

The limited knowledge of and the absence of any reliable data on, incandescent lamps led the Institute to invite the manufacturers of to place samples of their lamps in the hands of an impartial committee of experts for a comparative test. The results were published in September, 1885, and from the official report a few facts have been compiled.

Five different manufacturers submitted their lamps, some submitting several batches of different voltages. The lamps were tested for duration or life, and before placing on test their initial efficiency per spherical candle-power was determined.

The following tabulated data is of six sets of lamps:

Make.	Average life.	Voltage.	Initial efficiency per spherical c. p.	Loss in c. p.
Weston	454 hrs	111	3.63	50 per cent.
White	274 "	50	4.08	? " "
Woodhouse & Rawson	290 "	55	5.56	33 " "
Stanley	430 "	96	3.92	37 " "
Stanley	294 "	44	3.45	31 " "
Edison	1026 "	97.9	4.48	35 " "

From the results as given in the table, it will be seen that the greatest depreciation in candle-power was 50 per cent., and the least, 33 per cent. This, however, can not be taken for any comparison, as the life of the lamps showed such a great disparity. The depreciation of the Edison lamps, which proved the superior in the test, was 35 per cent. These results are looked upon to-day as of little practical value except as historical record, but they have taught us that lamps are a delicate matter to handle, and whether a lamp possesses value depends on many circumstances. These results were a valuable round added to the ladder of knowledge, and it is hoped that experiments of a like nature, yet of more practical value will be made in the near future for the benefit of the incandescent lighting plants and the men interested in incandescent lighting.

Since 1884 many other makes of lamps have come on the market, and knowledge gained by experience has both improved the quality of the lamps and cheapened the process of manufacture. In 1884, lamps were advertised, 16-candle power, $3; to-day from 40 cents to 60 cents may be taken as an average price.

Six years now have passed since the Franklin Institute experiments, and we are almost as much in the dark as in the earlier days of the industry. The question of life seems to be the most important factor to be considered from the central station point of view, and to meet this desire various manufacturers frequently guarantee the average life of their lamps. Those guaranteeing the longest life and at the same time proving their guarantee, usually get the majority of the business.

From time to time we hear of some remarkable lamp whose life has run into the thousands of hours, and often have I heard the veracity of a man's statement questioned when he has given some facts in regard to long-lived lamps. In my own experience I can relate of a lamp burning from seven to ten hours a day for six years, which would mean a minimum life of 13,000 hours. Yet, to make this statement off-hand to the general public, and even to the electrical fraternity, it would be received with doubt. There is not, however, the least trouble in making an incandescent lamp for any desired life. The life of a lamp depends upon the efficiency at which it is burned.

John W. Howell, in 1888, published a statement based upon the experiments of the Edison company, which covered five years of time, and the use of thousands of lamps. In this statement he says the life of a lamp burned at two watts efficiency was practically zero; at three watts per candle it was 1,000 hours; at four and three-fourths watts per candle power it was 16,000 hours. This at once shows that the question of life is merely a question of circumstances and may or may not be advantageous. He also stated in the same paper that the candle power of any lamp depends upon the efficiency at which it is burned. An Edison lamp gave five candle power when run at 6.7 watts per candle power, and when the efficiency was increased to 2.66 watts, the candle power was increased to twenty, this variation depending upon the electromotive force operating the lamps.

These statements show that the Edison lamps follow a law. All makes of lamps follow this same general law, each having its own especial curve, and it is this curve that gives the average quality of the lamp.

The object of an incandescent lighting station is to produce light. It is necessary to develop electrical energy, but it is the lamp that transforms this electrical energy into light. The electrical energy represents the dollars of the investor and operators of the station, and it is most important that it should be used with the greatest economy to obtain proper reward for the investor.

This must needs bring into the question the lamp used—the life, the cost, and the efficiency being the three considerations.

To bring the matter to a point at once we will assume conditions which are perfectly feasible and within the bounds of possibility. First, we will consider that a lamp burning at 4 1-2 watts efficiency will depreciate but a minimum for the first 1,000 hours. We will consider this lamp and the cost of operating it. A lamp at 4 1-2 watts efficiency and 16 candle power burning for 1,000 hours would require a total expenditure of electrical energy of 72,000 watt hours. This at one cent for 50 watt hours would be $14.40, for the current, and adding 50 cents for the cost of the lamp would make a total cost of $14.90, for burning this lamp 1,000 hours. The efficiency of another lamp is 3 1-2 watts per candle power. We will not say how many lamps will have to be replaced in the 1 000 hours, but just assume that the efficiency of 3 1-2 watts per candle power is maintained throughout the 1,000 hours. The total expenditure of energy on this basis will be 56.000 watt hours, which will cost, at the rate of one cent for 50 watt hours, $11.20. Adding 50 cents to this for the cost of the first lamp, makes it $11.70, leaving a difference in favor of the 3 1-2 watt lamp of $3.20, which of course will have to be used to a certain extent in replacing the lamps, but allowing that a 3 1-2 watt lamp will maintain its efficiency for 333 hours we will merely have to pay $1 00 additional for replacing lamps and have a net saving of $2.20. This, though an assumption, is not distorted, for lamps from 3 1-2 to 4 1-2 watts' efficiency are on the market, and yet, many a station is being operated with lamps of a worse efficiency than 4 1-2 watts, and they wonder why it is that their dividends are smaller than those of other plants. It is the incandescent lamp that will make or break the dividend paying record of the central station and it should be considered with the utmost care. The assumption has been made and the question been analyzed. The lack of actual data makes it necessary to assume and analyze the question as it has just been done. However, the London *Electrical Review* has published some facts which will be analyzed as this assumption has been, and will show immediately the advisability of maintaining efficient lamps on a circuit, even though their life be short.

The facts published by the London *Electrical Review* were an account of a test on Edison Swan lamps and the results were presented in tabulated form, giving the initial candle power, the initial efficiency and the total watts used on the lamp. A test of 1,000 hours' duration was started and at the end of each 100 hours observations were made as to the candle power and the total energy, the efficiency of the lamps being computed and placed in the table. This table is presented to you in this article with the deductions drawn from the data as given—the first four columns of the data as furnished by the *Electrical Review*, the other columns are deductions drawn from the first four columns.

Table B.

Hours.	c. p.	Watts per c. p.	Total watts.	Average of each 100 hours. Average c. p.	Average of each 100 hours. Average total watts.	Cost figured on the basis of 1c. for 50 watt hrs. Cost for each 100 hrs.	Cost figured on the basis of 1c. for 50 watt hrs. Cost of 16 c.p. at 100 hrs.
0	19.3	3.34	64.40				
100	18.8	3.45	61.86	19.05	64.66	$1.293	$1.08
200	17.2	3.79	65.19	18.00	65.03	1.300	1.10
300	15.6	4.10	63.96	16.40	64.57	1.297	1.26
400	15.2	4.17	63.38	15.40	63.97	1.270	1.32
500	14.8	4.29	63.49	15.00	63.44	1.268	1.35
600	14.4	4.38	63.07	14.60	63.28	1.264	1.38
700	14.1	4.50	62.45	14.25	63.21	1.265	1.42
800	13.3	4.68	62.24	13.70	62.85	1.257	1.47
900	12.4	4.90	60.76	12.85	61.50	1.220	1.53
1000	12.0	5.00	60.00	12.20	60.38	1.207	1.58

Column seven shows what the customer pays each 100 hours for the lamp he is using. Column eight shows what he pays for each 16 candle power of light he gets for each of the 100 hours. These figures are computed upon the average of the observations; that is, for the first 100 hours the average candle power produced is taken, and so on, for each succeeding 100 hours. The cost of the electrical energy used in the estimate is one cent per 50 watt hours, the prevailing price at the present day.

The potential in these experiments was constant, the same as any ordinary central station endeavors to maintain. The resistance of the filament increases as the lamp continues to burn, and the total energy used, when the potential is constant, decreases and the lamp takes less current to a small extent than when it starts to burn. The relation of the candle power to the total energy shows, though less energy is used as the life continues, that the economy of the lamp is greatly lessened because the light produced decreases (due to the depreciation of the filament and the discoloration of the glass) in a much greater proportion than the total energy.

As the light decreases in a much greater proportion than the energy, which is what we pay for, the light being the result, however, that we desire, it is easy to see that we are paying more for our light as the lamp continues to burn.

If we wish to maintain a constant candle power throughout the entire life of a lamp, the electromotive force will have to be raised as the filament increases in resistance. The discoloration of the glass and the depreciation in the quality of the filament also make an additional increase in the electromotive force necessary, the current is maintained up to what it was at the start, and even increased. Thus the energy required to produce a constant supply of light would be constantly increasing, and therefore the cost of the light constantly increasing as the life of the lamp continues.

Dr. Philip Atkinson of Chicago, in a recent lecture in which he advocated the economy of the renewals of incandescent lamps at much shorter intervals than the usual practice, unfortunately gave as the reason that the filament's resistance was reduced the longer the lamp was used, whereby the current is increased while at the same time the luminosity is decreased.

He is wrong in regard to the resistance of the filament and the increase of current, for the incandescent lamp as it grows old takes less current whenever the potential is constant.

Attention is called to Dr. Atkinson's reasons, so that others may not be misled by his incorrect premises, even though they may have been used to prove an assumption that is supported by facts. There is nothing so detrimental to a cause as false and incorrect premises.

The financial results in table "B" are very clear and plain, and any one would say at a glance, allowing that a 16-candle power lamp costs 50 cents, that it would not cost the consumer a cent more for light if he bought a new lamp at the end of 900 hours, for the saving in current would pay for the lamp; that much is apparent. However, the following table makes the matter clearer and more closely defines the line of the most economical life of the lamp. The lamps are assumed in this table to cost the consumer 50 cents; the cost of the current is taken from the table just previous to this.

Table C.

Number of Hours to Burn.	Cost of Current for 16 c. p	Cost of Lamps.	Total Cost Current and Lamps for 1,000 Hours.
Lamps replaced every 100 hours	10.80	5.00	$15.80
Lamps replaced every 200 hours	11.20	2.50	13.70
Figured on a basis of 1,200 hours and reduced to 10-12. Lamps replaced every 300 hours.	11.66	1.66	13.32
Figured on a basis of 1,200 hours and reduced to 10-12. Lamps replaced every 400 hours.	12.05	1.25	13.30
Lamps replaced every 500 hours	12.34	1.00	13.34
Figured on a basis of 1,200 hours and reduced to 10-12. Lamps replaced every 600 hours.	12.68	.83	13.51
Figured on a basis of 1,400 hours and reduced to 10-14. Lamps replaced every 700 hours.	12.81	71	13 52
Figured on a basis of 1,600 hours and reduced to 10-16. Lamps replaced every 800 hours.	13.05	.62	13.67
Figured on a basis of 1,800 hours and reduced to 10-18. Lamps replaced every 900 hours.	13.30	.55	13 85
Lamps replaced every 1,000 hours	13.55	.50	14 05

The result of the above compilation shows that for this grade of lamp at the price of current and the price of lamp assumed, that though the lamp will last 1,000 hours it is better to throw the lamp away at the end of 400 hours and use new ones. Seventy-five cents per lamp will be saved every 1,000 hours by replacing the lamps every 400 hours instead of keeping one lamp in 1,000 hours.

If the lamps were cheaper and the current the same, or dearer, it would be cheaper to replace the lamps still oftener than 400 hours. If the current was but half of what is assumed in the compilation, that is, if the current cost but one cent for 100 watt hours, it would be cheaper to replace the lamps every 700 hours, cheaper by about 17 cents for every 1,000 hours.

It is not a question of the life of a lamp alone, that should determine what lamps should be used, but also the efficiency of the lamp, cost of current, and price of lamp.

A mathematical equation should be formed taking all these factors into consideration before the matter should be decided by the central station. Reliable data on the majority of the makes of the lamps are not obtainable, and it has been necessary to treat the matter from assumption and from analyzing such data as have been published; but even from mere assumption it is, without doubt, an assured fact, except when the current is extremely cheap, that an efficient, short-lived lamp is preferable to an inefficient long-lived lamp.

In making this mathematical equation the end in view is to determine the efficiency at which the sum of the costs of power and lamps is a minimum, and in order to do this the rate of variation of life of a lamp with its efficiency, should be known, This variation would have to be given by the manufacturer.

To give this equation in the shape of a formula we will assume symbols to represent the various factors.

Let A=the number of watt hours required by a 16-candle power lamp. A÷16 would represent the efficiency per candle power.

Let B=the life of the lamp at A÷16 efficiency.

Let Y=the cost of a 16-candle power lamp.

Let X=the cost of a watt hour delivered at the lamp.

The value of A and B must be ascertained from the manufacturer.

Y is the price that has to be paid for the lamp.

To obtain the cost of a watt hour, or X, delivered at the lamp, the mean current at the station must be determined. As the wires and devices have been figured for a certain loss for maximum current, the energy in transmitting the mean current would bear the same ratio to the percent-

[1] Read before the Chicago Electric Club, April 20, 1891.

age, figured for the maximum load, as the mean current does to the maximum current. This amount of energy must be subtracted from the total energy developed and the remainder will give the amount of energy used in the lamps. The total operating expenses, less the cost of lamps, divided by the total watt hours delivered at the lamps, will give the cost of one watt hour.

The cost of operating a 16-candle power lamp for an hour would be the cost of a watt hour multiplied by the number of watts required by the 16 candle power lamp, or $X \times A$.

The proportion of cost for replacing lamps would be the price of the lamps divided by the life, or $Y \div B$.

The most economical point to run the station would be when the sum of the renewals and the cost of the energy is a minimum or expressed in a formula, when $(Y \div B) + (X \times A) =$ a minimum.

To give an example of this we will assume conditions. Let cost of lamp=50 cents, efficiency $A \div 16 = 4$ watts, or $A = 64$ watts; let $X = \$.00016$, an average cost of electrical energy (being .8 of a cent for 50 watt hours), and the life of lamp 1,000 hours, and substituting these values in the formula we have $\$.50 \div 1{,}000 + \$.00016 \times 64 = ?$ or $\$.0005 + \$.01024 = \$.01074$.

Another lamp costs 60 cents, its efficiency is 3 watts or $A = 48$ watts. $X =$ the same as in previous case, $\$.00016$, and the life of lamp 300 hours, substituting these values in the formula, we have $\$.60 \div 300 + \$.00016 \times 48 = ?$ or $\$.002 + \$.00768 = \$.00968$.

The result shows that a lamp costing 60 cents and having a life of only 300 hours with 3 watts' efficiency makes the operating expenses of the station less than if the lamp was only 50 cents and had a life of 1,000 hours with 4 watts' efficiency; in fact the 3-watt lamp is cheaper even though the 4-watt lamp cost but 1 cent and had a life of 10,000 hours, for the cost of the energy alone, for the 4-watt lamp is in excess of the sum of the cost of the lamp and energy in the case of the 3-watt lamp. The question is governed very much by the cost of the energy.

The incandescent lighting business has grown upon us so rapidly that we have been unable to keep up with the great advance, and the public has been suffered to remain in dense ignorance on one of the most important subjects of the present day. In fact, not only has the public been allowed to remain ignorant, but the great majority of central station men have had no opportunity whatever of gathering such data together that would enable them to fully comprehend the important part the incandescent lamp plays in their business, and wherein lay vital considerations.

The renewals have always been considered the bugbear of the central station, but the waste of energy has seldom received the slightest notice.

The success or failure of electric light central stations as dividend earning investments, is of the utmost moment to the agents, manufacturers of electric light apparatus and others who desire to promote the business. It is necessary for the success of those desiring to promote the electric light business that the electric light central stations make money. For the electric light central stations to be financially successful, those operating them should be convinced of the importance of using efficient lamps and of renewing them as soon as their efficiency materially depreciates.

The bugbear that exists in the minds of many central station men that it is the cost of renewal of lamps that represents the great expense, should be eradicated and the question of waste of energy so demonstrated that they can not avoid seeing the advisability of efficiency rather than long life in the lamps they are using.

Novel Use of the Telephone.

A company has been formed in Paris to organize a telephonic theatrical service. The company has erected in various public places, such as cafes, clubs, restaurants, etc., a certain number of automatic telephone receivers by which, on introducing a fifty centime piece, one is placed in communication, for five minutes, with theaters or concerts indicated on the apparatus. At present the Opera Comique, the Bouffes, and the Nouveautes are the only theaters in connection with the system, but the number will be soon increased. The Theatrophone company, as it is called, intends to supplement this public service by a private service, available for all subscribers to the state telephone system. By means of monthly subscription of fifteen francs, and a payment of fifteen francs per evening for this service, a subscriber to the Paris system can enjoy telephonic communication with a given theater, selected from among those connected with the service, during the entire performance, and for any number of listeners The prices given above are for two receivers. The addition of extra telephones, so that several persons may hear at once, entails a further charge of two francs per pair per month.

Employment of Electricity In Mines.

The interest shown by engineers generally in the application of electricity is highly gratifying to all who are directly interested in electrical development. The employment of electricity in mining is one of the most important advances that has been made from a commercial standpoint. An English mining journal referring to the application of electricity to mining, says: "It is not wonderful that the electrical transmission of power, affording as it does the means of utilizing cheap sources of power in the most convenient form should have secured a rapid adoption amongst mining engineers, and that the question of its relative value to that of other means of power transmission should be one of exceptional interest to the members of that profession."

An abstract from an interesting article on this subject in the *Mining Journal* follows The extensive employment which electricity is destined to secure in mines is evidenced in the fact that one firm of English engineers has alone supplied electrical mining plant to the extent of more than 1,200 horse power. In the United States and in Germany electricity has been employed with the most exceptional success for the communication of power from rivers and waterfalls to actuate mining machinery at a distance of a considerable number of miles. Heavy orders for electric mining plants have lately been placed in the newer coal mining districts of the United States, and at the iron mines of Ironwood (Michigan) the electric power is used for both the illumination of the workings and the extraction of the ores. There are not less than 1,200 lamps of 16-candle power distributed through the workings of this mine, and the machines actuated include a large number of very varying power. Indeed, one of the chief advantages of electricity is the readiness and economy with which it can be adapted to the continual fluctuations in the demand upon it. This quality of electricity seems to give it a promising future as the means of supplying power to apparatus employed for the direct extraction of mineral. The drawbacks which attend the employment of labor in mines render any solution of the difficulty of adapting mechanical means to the work of the miner an important benefit to the mine owner, and electricity has in this direction considerable advantages over other forms of power. The electrical coal cutting machine employed at Lord St. Oswald's colliery at Nostell has bored 55 yards, to an average depth of 3 feet 8 inches in an hour and a quarter, and the cost of its working is less by 1s. 6d. per ton than that of cutting by hand. This apparatus has a cutter of the bar type revolving upon its axis, and is driven by a dynamo having nominally 10-horse power, situated at a distance of about a mile. Electrical transmission of power as a mining expedient is destined, undoubtedly, to take a high place in mining mechanics in the future, and its advocates would say that its employment is not confined to cases in which transmission is required over exceptionally long distances from the source of supply. They urge that electric power is cheaper both in the first cost and expense of maintenance than compressed air or any other form of power transmission, and that it is peculiarly suited to the needs of an industry in which it is required to continually remove machines from place to place. It may be added to these advantages that electric cables are easier to maintain in an efficient state than steam, or air, or hydraulic pipes, and that, moreover, an electric plant can be utilized for the lighting of a mine as well as for the transmission of power.

Against the admitted conveniences and advantages of electric power in mines, there are to be urged certain objections which, though serious enough in themselves, are probably only of temporary duration—that is to say, that the lessons of experience will produce improvements in the electrical apparatus sufficient to obviate these difficulties. The principal danger in the employment of electrical apparatus is its liability to sparking, which might produce serious accidents in many mines. On this point Messrs. Atkinson recently stated before the Institution of Civil Engineers that they had experimented by filling with coal gas the chamber inclosing the commutator and brushes of their motor. After five hours they drew out a quantity, and after admitting atmospheric air in measured proportions they attempted to explode it, and only after obtaining such an atmosphere as would never be reached in mines were they enabled to do so. Mr. Snell, of Immisch & Co., whose practical experience upon the matter makes him as good an authority as can be desired, declares that little is to be feared from sparking. While every precaution should be taken, the best safeguard is perfect ventilation in the vicinity of the motor. It may, therefore, be concluded that electric transmission is suitable for employment under proper safeguards in the majority of metalliferous mines. It is urged that the results obtained in special and trial installations of electrical machinery can hardly be expected in general working, under which the most simple class of machinery suffers a material decline from its theoretical efficiency. To this it may be answered that the satisfactory character of electrical machinery in actual working is proved by the additions to plants which have been made, and the repeat orders which have been given by mine-owners who have adopted this method of power transmission.

But though the question of relative efficiency may be of the principal importance in settling the question in a country like England, it does not take the supreme place for a mining engineer who has to make an installation in a new and unopened-up country. Under such conditions convenience and rapidity of erection are often the primary factors in determining the adoption of plant, and when coal is dear and water power is available at a moderate distance it seems nearly certain that electricity will have the preference. Moreover, in places where labor is scarce electricity is, perhaps, the most ready and convenient method of applying power to a number of small machines scattered over a wide area. In the coal mines of this country, also, it is probable that electricity will gain a wider employment as new inventions lessen the liability of explosion in fiery mines.

It should not, however, be lost sight of that the use of electricity in metalliferous mines is not to be confined to the purposes of lighting and to the working of machines. It has yet a very much wider range of capabilities. Its value as a means of transporting mineral and materials over inaccessible ground, and in countries where the ordinary means of communication do not exist, has already been fully demonstrated. The application of electricity to the welding of metals, and of their disposition, has also secured important practical successes, and it is impossible to say how far the employment of the force will be carried. What is certain is that it will be more and more largely employed in mining, though it does not follow that it will displace the systems of power transmission already in use. Mining is pursued under all sorts of conditions, and there is consequently room for a large variety in the appliances which are employed in it. Mining engineers cannot afford to overlook the fact that electricity now occupies a position of ascertained value among the resources of their profession. The paper and the discussion at the Institution of Civil Engineers show that both its capabilities and limitations have been carefully determined in actual practice, and that it has long since passed beyond the experimental stage as a means of transmitting power through the workings of a mine.

Employment of Electricity in Dentistry.

In a recent number of the London *Electrical Review* a description of what is styled "a demonstration of the new dental vibrator" is given. The vibrator, it is said, does not depend for the resultant insensibility produced on the use of anæsthetics, but proceeds on the principle of setting up in the nerve of the tooth a series of extremely rapid vibrations, which effectually prevent the sensation of pain, the action of the instrument being divertant and not anæsthetic. The apparatus consists of a small Ruhmkorff induction coil, made with an extremely fine wire, and having a delicate and highly-strung spring armature. The patient is placed in the ordinary dentist's chair, with the negative electrode in his left hand and the positive in his right. The current is turned on until the patient signifies that it is as strong as he can bear. The forceps are then connected by a conductor with the other portions of the positive electrode, and, everything being prepared for the extraction, the patient grasps the handles as tightly as possible. The actual extraction is then at once proceeded with, the current being turned on for the purpose. The moment the tooth is extracted the current is cut off. The patient experiences no pain during the operation, but is merely conscious of a tingling of the hands and the forearms, resembling that commonly described as "pins and needles."

A New Chicago Enterprise.

Western electrical men are often referred to as an unusually enterprising class, and it is their ability to quickly recognize the needs of the trade that entitles them to this distinction. At the beginning of the present period of prosperity in the electrical supply business the West did but little toward producing the goods for which there is now such a great demand. At the present time, however, the westerner is beginning to appreciate the advantages to be gained through the encouragement of home enterprise. On all sides there exists a feeling that Chicago, while still retaining the distinction of being the chief distributing point for the wares of eastern manufacturers, will also become the manufacturing center of the West. In several lines a great deal of progress has already been made, but one branch in particular is worthy of special mention. The home of the insulated wire manufacturer has been in the past in the East, but now Chicagoans are entering the field and, with their usual energy, already commanding their rightful share of the trade. About four months ago a party of Chicago capitalists decided that the demand for high grade insulated wire had beeome such as to warrant the erection of a local factory. Accordingly a company was formed under the aame of the Chicago Insulated Wire company, and all the necessary machinery was installed at 48, 50 and 52 N. Clinton street. From the start this concern has met with encouragement. Operations were begun with 10 to 12 hands in a factory having a floor space of 65x165 feet. Now we are informed that the company has on its pay roll about 35 men and will shortly require additional room for new machinery. The business of the Chicago Insulated Wire company is under the direction of H. P. Lucas, who holds the position of general manager and treasurer of the company. Mr. Lucas has had the benefit of a long experience in the wire business. It will be remembered that he was formerly connected with Holmes, Booth & Haydens of New York, and recently with the Great Western Electric Supply company, Chicago.

The Writing Telegraph.

Under an unassuming title an eastern company is presenting the business world an invention which the projectors claim is not second to the telegraph or telephone. It is the writing telegraph. The apparatus is not complicated, and in a few moments' time the novice is able to write with a stylus fixed permanently to the base of the instrument by means of a very fine steel wire. The same wire holds a carbon cube in front of the poles of two electro magnets, placed a short distance apart, and at right angles to each other. These magnets are actuated by an undulatory current passing over a separate wire, forming a text hard to be distinguished from the original. As the hand moves the stylus to make the letters, the carbon is carried first in close proximity to and then away from the poles of the magnets, and by so doing increases and decreases the current waves, changing the strength of the magnets at the opposite ends of the lines. This serves to move a fountain pen attached to another steel wire and carbon cube, exactly duplicating the letters as formed by the writer. This pen rests upon a tape of paper controlled by clock work. Two separate wires are necessary, but beyond this the fixtures are simple and inexpensive, and it is believed by the promoters that it is destined to take the place of the telephone, at least for long distance work. The leading advantage claimed for the device is that it makes a record. The Writing Telegraph company of New York is forming companies throughout the country. One has been organized at Indianapolis for the State of Indiana. An exhibition of the apparatus was recently given on the lines of the Postal Telegraph company, between Indianapolis and Crawfordsville, and later between Ft. Wayne, Ind., and Van Wert, Ohio, attracting much attention.

George Carleton, city electrician of Oakland, Cal., has decided not to recommend the laying of electric wires underground, but suggests they be placed on poles 50 to 75 feet high.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 18.—The arguments in favor of the Clark bill for the extension of the terminal facilities of the elevated railroad at Battery Park were presented to the Assembly Railroad committee last Tuesday. The hearing assembled the largest array of representatives of different interests that has come before the committee this season. F. B. Thurber spoke in favor of the bill in the interests of the merchants, Cyrus Clark for the west side association, Lasen N. Fuller for the Washington Heights Taxpayer's association and F. G. Gedney for the public. Assistant Corporation Counsel Blandy stated that the city authorities were opposed to taking any more of Battery Park for the elevated road, but the opposition to the bill did not seem sufficiently strong to be further represented. The passage of this bill is expected, and a temporary relief will be had until the great underground electric system can be constructed toward which public sentiment is being directed with energy.

The Metropolitan Telephone company was censured by the coroner's jury for maintaining a pole that was rotten, and only held in place by a wire. At the corner of Twelfth street and Avenue B, Thomas Bowman, a lineman, fell with the pole and was instantly killed.

A system of audible signals in the railroad tunnel is said to work well, and the idea of lighting by electricity has been abandoned. W. H. T.

San Francisco, Cal.

SAN FRANCISCO, Cal., April 18.—At last it appears that San Francisco is to have an electric road, as work has been commenced on the San Francisco & San Mateo Railway company's proposed line between the cities named. Like every horse or cable line here, the new electric road will find its city terminus at the Oakland ferries. It will thence run along Stewart street to Harrison, thence out through the Mission and over the hills to San Mateo, a total distance of 14.7 miles. The contract was secured by the Pacific rolling mills of this city, who, it is understood, represent the Westinghouse electric street railway interest, which system is to be used. The contract calls for the placing of sixty cars and the completion of the road within one year. The rails are now on the ground, and work is being pushed rapidly, although formidable obstacles are being met. The most serious of these presented itself when an order was introduced before the Board of Supervisors, limiting the rights of persons or corporations to operate overhead electric railway systems in that portion of San Francisco within a line drawn from the intersection of the westerly line of Van Ness avenue and the Bay along Van Ness avenue to Market, to Eleventh to Bryant, to Tenth, to Channell, to Potrero avenue, to Alameda, to Eighth, to Channell, to the bulkhead or sea wall, thence to the point of beginning. This includes all the business portion of the city. The order, which was passed to print, is made applicable to all franchises which have been granted, or which may hereafter be granted, and any person or corporation violating its provisions shall immediately forfeit all privileges and franchises which may have been granted. J. W. Hartzell, the manager of the proposed San Mateo road, takes the matter very quietly. He says: "If the supervisors can over-ride the state law, we shall have to put in a cable as far as Tenth street, from the junction of Market and Stewart streets. Beyond this the order will not affect us." From this it is evident that the validity of the ordinance is to be tested.

Notice is published in the daily papers to the effect that Wan Yune Lung Kee & Co., and Lee Shew Chaw have ceased to be the agents of the Canton Electric Light company of Canton, China, the agency having been transferred to Wong Wee San, Lew Hing Lung, Lee Shee Gi and Woo Chung Poo of San Francisco, who will transact the United States business of the company. The Edison General Electric company is shipping five 20-light and one 45-light Edison 100-volt dynamos to the Canton company this week. These are to be used as exhibition plants by the Canton company in different cities in China, and will be gazed upon by thousands of curious celestials.

The Pacific rolling mills of San Francisco have commenced work on the new line of the Consolidated Electric Railway company of Los Angeles.

Modesto, Cal., was lighted by electricity for the first time on the evening of April 8th. The National electric alternating incandescent system is used, and 450 lights are in operation.

C. M. Spaulding of the Electrical Supply company of Chicago has been "doing" California for the past month. He leaves for the Northern Pacific states this week.

Judge Sawyer of the United States District Court has rendered a decision in the suit brought by the chief of the fire department against the Electric Improvement company to compel the latter to remove its housetop circuits. The court held the ordinance prohibiting housetop circuits to be valid, and that the wires must come down, but the decision is generally esteemed of value only as a precedent. As the Improvement company was refused a franchise, and as it was compelled to run housetop circuits in order to carry on its business, the enforcement of the order will drive it out of the field for a time at least.

P. F. Morey, manager of the Willamette Falls Electric company of Portland, Ore., has been in San Francisco during the present week. The new tertiary alternating system installed by the Westinghouse company for Mr. Morey's company is now in full operation, and gives complete satisfaction. The dynamos, located at Oregon City, generate an alternating current of a potential of 4,000 volts. This is carried over a twenty-six mile circuit to the Portland sub station, where it is reduced to 1,000 volts for city distribution. Current is supplied to consumers at 50 volts. Another noteworthy feature of the Portland plant is the voltage of the Westinghouse alternating arc system used for street lighting only. Its potential is 6,000 volts. The old steam electric light station at Portland has been abandoned, and all the electric lights in the city, both arc and incandescent, are operated from the water power plant at Oregon City. A new company, allied to the Willamette Falls Electric company, has just been incorporated, and its ultimate purpose is to deliver electric power at Portland, the generators being located at Oregon City.

The contract for the wiring and equipment of the Mills building, San Francisco, with a 3,100 light incandescent plant has been awarded to the Edison General Electric company.

Ben Franklin of San Francisco and S. F. B. Morse of Kansas City are two gentlemen who are following electrical pursuits in their respective cities, and who are very warm friends. They are, moreover, as fine fellows as their names are illustrious.

The installation of one of the largest private residence plants in the West, if not in the country, has just been completed by the Pacific Electrical Storage company of San Francisco for J. O. Hayes at Eden Vale, Santa Clara county, Cal. It consists of 520 lights, and the dynamo plant is supplemented by two series of "15 L" accumulators of 55 cells each. Mr. Hayes expresses himself as being delighted with the plant.

The Omnibus Cable Railway company has applied to the San Francisco Board of Supervisors for permission to run street cars by the overhead electric system over several streets for which horse and cable railway franchises have been previously granted. Consideration of the petition was deferred one week, pending action by the Board on the order forbidding the erection of overhead electric railway circuits within certain limits.

The Gilroy, Cal., city trustees have granted a franchise to Mr. Swanton of Santa Cruz, for the erection of an electric light plant, the same to be in operation not later than October 1, 1891. S. F.

Pittsburg, Pa.

PITTSBURG, Pa., April 18.—A number of the representatives of the electric light companies of Western Pennsylvania held a meeting at the hotel Anderson in this city on Tuesday for the purpose of forming an organization for mutual assistance. It was expected that about sixty or seventy representatives would be present, but for some reason or other there were not more than ten. On this account much of the business had to be postponed until the next meeting. Dr. G. M. Getze of Tarentum was made president and Mr. Pierce of Wilkinsburg was elected secretary. One of the gentlemen present stated that it was thought to be quite likely that a uniform basis of rates might be established in all towns of Western Pennsylvania. The members are expected to meet occasionally to discuss improvements and such matters as will tend to advance the business. At the meeting the question was discussed whether it was better to make charges for the consumption of electric current by contract or by the meter system. All except one preferred to sell electricity by contract. The objector claimed that he sold both natural gas and electric light by meter, and he preferred that system to all others.

The Second Avenue Electric Street Railway company has now one of its new vestibule cars running. The car is equipped with the Westinghouse slow speed single reduction motors, and the whole outfit of car and motors is considered a great improvement over the old style of road equipment that has been in use on the line so far.

The Allegheny County Electric Light company will remove its power house from Virgin alley into its new quarters on Twelfth street as soon as the building is finished. Ground for the foundation was broken several weeks ago, and the walls are being pushed as rapidly as possible. E. H. H.

Detroit, Mich.

DETROIT, Mich., April 18.—The Brush Electric Light company of Detroit has brought action against the Detroit Electric Light & Power company for an alleged infringement of patent on the double carbon Brush lamp. An effort has heretofore been made to settle this difficulty by arbitration, but without success. The situation is peculiar on account of the relations between the Brush company of Cleveland, which controls the patent, and the Detroit Brush company. The case has been taken under advisement by Judge Swan.

Detroit city railway officers have been in Cleveland inspecting the rapid transit service in that city.

The copper miners in the Upper Peninsula say the benefits from the use of the electric light are more than enough to warrant the difference in price between them and the oil lamps; the saving in copper alone is said to be considerable.

Plans have been prepared for the establishment of a street car line from Benton Harbor's business center to the mills, the cars to be run by electric power. The dynamos will be located near the mills, and will furnish electric light and power for light machinery.

An electric bell and alarm company from Rockford will move into new buildings now being erected for it at Muskegon, Mich.

An electric light plant has been established in Coldwater.

Menominee is to have an electric railroad this year, and nearly all of the $95,000 necessary has already been subscribed.

It is now assured that an electric road will be built this season to connect Negaunee and Ishpeming.

According to statistics there are more telephones in use at Three Rivers than in any other town of the same size in the United States.

The Union Street railroad of Bay City and the West Bay City railroad company will be equipped with electricity.

The Bay City board of electric control has given the electric companies permission to string wires in the streets.

Leslie is to be lighted by electricity at a cost of $1,000 per year.

The Grand Rapids Cable company has closed a contract with the Edison Light & Power company to furnish power until its own power house is completed.

In the Michigan legislature the judicary committee has reported favorably a bill to authorize the incorporation of companies to furnish automatic electric fire alarms.

The senate favorably reported Senator Park's bill to regulate the hours of labor of street railway employes. It specifies that hereafter 10 hours' work in any 24 hours, with not less than half an hour for meals, shall constitute a day's labor, in the operation of any street railway, no matter what motive power is used. The bill also says that only six days' labor out of the seven shall be required of any employe.

The House committee on state affairs agreed to report favorably Representative Richardson's bill to reduce the rate of telegraph messages. As amended, the bill provides that the rate for a 10-word message in Michigan shall be 20 cents, and each additional word 1 cent. This is a reduction of 5 cents on the present price of a 10-word message, and a reduction of one-half the present rate for the extra words.

Seven bills, five from the House and two from the Senate, all providing for the establishment of electric light plants in various cities and villages of the state, were reported without recommendation by the committee on municipal corporations. The chairman explains the action of the committee by saying that the bills authorized the several municipalities to issue bonds for the introduction of electric light plants, and the committee does not care to take the responsibility of recommending such action.

A bill has passed the House authorizing Edmore to borrow money to establish an electric light plant. F. W. G.

Nashville, Tenn.

NASHVILLE, Tenn., April 18.—Dangerfield Deaderick has filed a bill in chancery asking the court to set aside the consolidation of the Nashville & Edgefield street railroad company with the Main Street & Lischey Avenue railroad company and to make the directors of the former company account for the bonds alleged to have been issued for the equipment of the line with electrical apparatus. The complainant claims that he is an original stockholder in the Nashville & Edgefield company and as such never assented to the purchase of the Main Street & Lischey Avenue line or to the consolidation with the United Electric company.

The projected Maplewood electric railroad has not yet

been begun on account of opposition on the part of the United Electric company, but the matter has at last been amicably adjusted. The agreement stipulates that the United Electric company is to build and operate this extension.

A four year old boy ran in front of an electric car recently and was killed. The motor man and the conductor were arrested, and while the proof showed that the former stopped the car within half a car length after he saw the danger there were three men on the coroner's jury who insisted on a verdict of "murder in the first degree," and would not agree to anything else. The coroner refused to sign such a verdict, dismissed the jury and empaneled another, which exonerated the motor man and the conductor. The case came up in the recorder's court yesterday and was dismissed, as the proof failed to sustain the charges.

The business of lighting the streets of Nashville by electricity has so far proved a losing one financially. The Nashville Light & Power company took the first contract and it is claimed lost $80,000 of paid up capital and became further involved to the extent of $27,000. The present contract was awarded to the Thomson-Houston company at 23½ cents per light per night, with a stipulation for a reduction to 23 cents when 300 lights should be put up. This company transferred the contract to the Capital Electric company. The price, however, was too low to prove remunerative. One entire circuit has been abandoned and gas substituted and a demand for additional lights by the board of public works found no response. The Thomson-Houston company of Boston has offered to pay $35,000 for the bonds issued by the Capital Electric company, to purchase the plant and franchises of the Nashville Light & Power company and carry out the present contract, which has something over a year yet to run The trustees and bond holders of the Capital Electric company filed a bill in chancery asking that the matter be referred to the clerk and master to take proof and report whether the proposition of the Thomson-Houston company would be to the interests of the stockholders and creditors of the Capital Electric company.

Robert Tindall has brought suit for $1,950 damages against the Western Union Telegraph company for alleged failure to properly deliver a telegram. B.

NEW INCORPORATIONS.

Gausevoort Electric Light company, Troy, N. Y.; capital stock $10,000; to operate an electric lighting system.

Bay City Gas, Water & Electric Works, Bay City, Cal.; capital stock $100,000; to operate gas, water and electric works.

Downer's Grove Electric Light company, Downer's Grove, Ill.; capital stock, $25 000; to furnish electricity for lighting purposes.

The Lancaster & Columbia Railway company, Lancaster, Pa.; capital stock $100,000; electric or other than steam power.

The Scranton & Carbondale Street Railway company, Scranton, Pa.; capital stock $96,000; running street railway by electric power.

The F. B. Morgan Power & Light company, Cincinnati, O.; capital stock $10,000; generating and supplying electricity for power, light and heat.

Dawn Electric company, Chicago, Ill; capital stock $20 000; electrical construction and the control, operation and sale of electricity, light and power.

Whitehall Electric Light and Power company, Whitehall, N. Y.; capital stock $50,000; the generation and sale of electricity for the purposes of illumination, heat and power.

Ruby City Water, Light & Power company, Ruby City, Ore.; capital stock $100,000; to equip and maintain an electric light and power plant, electric street railway and telephone exchange.

The Painesville, Fairport & Richmond Street Railway company, Painesville, O.; capital stock $50,000; building a street railroad to be operated by horse, electricity or other motive power, etc.

Northwest Electric Engineering company, Portland, Ore.; capital stock $40,000; to supply and manufacture electrical goods, apparatus and machinery of any kind and every nature or description, and generate, manufacture and sell electricity.

The Edgewood Electric Light, Heat & Power company, Edgewood, Allegheny county, Pa.; capital stock $1,000; supplying light, heat and power by means of electricity to the public in the Borough of Edgewood County, of Allegheny, and to persons, partnerships, etc.

ELECTRIC LIGHTING.

The city of Wheeling, W. Va., will erect an electric light plant.

An electric light plant is to be erected at Longview, Texas.

At Alexandria, La., an electric lighting company is talked of.

Pulaski, Tenn., contemplates the erection of an electric lighting plant.

The erection of an electric plant at Russellville, Ark., is contemplated.

The Board of Trade of Chestertown, Md., proposes to ntroduce electric lighting.

The newly organized Electric Light & Power company of Greenville, S. C., has a fifteen year contract to light the city.

The Texarkana, Ark., Light & Power company has been incorporated to purchase and operate a gas and electric light plant.

Chehalis, Wash., will put in a street lighting plant of its own at a cost of $10,400. The dynamos will be driven by power obtained from a flour mill.

The Municipal Council of Antwerp, Belgium, is discussing a project for an installation of electric lighting, for which the motive power will be supplied by turbines.

The large building for the Mansfield Electric Light company's plant at Mansfield, Pa., is completed, and the machinery is being put in. Poles are up on the main streets and wires are being strung. Light will be supplied in a short time. It is the purpose of the company to supply light to the boroughs, and citizens of Mansfield and Chartiers, and to surrounding towns, including Idlewood and Crafton.

The city authorities of Agram, the capital of the Hungarian crown territory of Croatia, has granted the International Electrical company of Vienna the concession for erecting works for supplying electric currents for lighting and for the transmission of power. The same town has lately granted a concession for the construction of a street railway for which electric motive power is also to be adopted.

The chief of the Boston fire department drives about in a wagon supplied with electric lights on either side of the seat. The current is supplied by a storage battery carried on the floor of the vehicle. When the wagon is not in use the storage battery is fed until charged, and the supply of electricity is always ready for instant use. The lamps will burn continuously for fifteen hours without recharging the battery, and, as each lamp is furnished with powerful reflectors, a very brilliant light is emitted.

The Brush Electric Illuminating company of New York City has obtained from Judge Patterson of the Supreme Court a writ of certiorari to review the action of State Comptroller Edward Wemple in levying taxes aggregating $10,752.50 for the years 1881 to 1888. The company was organized under the general manufacturing act of 1848, and claimed exemption from taxation under the act of 1880, but the comptroller holds that the section relied upon does not apply to corporations producing electricity for light, heat and power.

The electric plant of the company that supplies Rome, Italy, with illumination consists of four dynamos driven by engines of 600 horse power each, two dynamos with engines of 150 horse power each, and one with an engine of 50 horse power; three exciters driven by engines of 40 horse power each, steam being supplied by fourteen boilers of 164 horse power each. The concentric high-tension cables used are 19,750 metres in length, and at the end of last year there were 143 transformers in use. The total number of lamps installed at the same date amounted to 11,156 of various powers, equal to 16,508 normal 16 candle power lamps. There has been an increase of 3,478 lamps of various types, equal to 6,051 normal 16 candle power lamps, during the past year. It has been said that this is one of the finest central stations on the alternating current system.

ELECTRIC RAILWAYS.

The building of an electrical road in South Austin, Tex., is contemplated.

An electric railway from Wilmington, Del., to Brandywine Springs is talked of.

It is proposed to extend the street railway of the Selma, Ala., Street Railway company a distance of seven miles to a health resort, and to change the city motors from dummy engines to electricity.

The city of San Jose, the capital of the republic of Costa Rica, is not only lighted by electricity, but has an electric railway in construction. The present plan is for two branches, embracing about six miles of road, and the equipment is to include both passenger and freight cars.

The interest taken by railroad men in the question of utilizing electricity as the motive power in long distance transportation has led the *Railroad Gazette* to begin the publication of a series of articles on 'Some considerations of electric motors for railroad use." The tenor of the first installment is hardly favorable, as will be seen by the following sentence: "No one has ever yet been able to prove it to be, in general, more economical to use electricity, except where the conditions are such as to render possible by its use the removal of some unusual expense, not common to the average conditions of operation of steam railroads."

The Bremen Tramways company has just decided to remove its horse cars from its lines and to substitute electric tramcars for the whole of the service in that town. The company has been induced to come to this decision on account of the excellent commercial and working results obtained with an experimental line laid down last summer. It is intended to adopt the Thomson-Houston overhead wire system, which is the method used in the trial tramway. The Imperial postal authorities objected to the use of the overhead conductor owing to the interruption in the telephone service, but, notwithstanding this, the police authorities have already given their permission for the use of the system. The senate is also prepared to give consent, and horse tramcars will therefore disappear from the streets of Bremen.

Speaking of the characteristic features of the City and South London electric railway, *Engineering* of New York says: "No electrical engineer who has had any experience with electric railways in this country ever felt any doubt that the electric motor was as competent to draw a train of cars at a high speed as to propel a single car at a comparatively low speed and many of them would have been only too glad to accept a contract to provide New York, or any other city, with just as perfect a system of underground electric transit as has recently been inaugurated in London. Hitherto New York has been blind to the advantages of electric traction, and many New Yorkers have never even seen an electric railway proper, although the storage battery car is now a familiar sight to most who travel by the East side. Now there can be no doubt that electric rapid transit has got to come, and New York wants the best and biggest and fastest system that civil and electrical engineers can give her—and she wants it just as soon as she can get it."

ELECTRIC MINING.

The Shawmut Coal company of Pennsylvania is using the new Lechner coal mining machine with great success, employing one generator and two motors. It has the greatest faith in electric mining machinery.

The Compagnie Continentale Edison installed an electric haulage plant last year in the Mines de Marles in France, and it has given such satisfaction that the original plant is now about to be considerably enlarged. The generator is an Edison machine, giving 400 volts at 900 revolutions. The pit is nearly 1,000 feet deep, and the line runs along a gallery one and one fourth miles in length. The locomotive is seven feet three inches long, two feet four inches broad, four feet eleven inches high, and weighs two tons, six hundred weight. The motor is arranged lengthwise, and drives on to both axles through doubled helicoidal gearing. A speed of over nine miles an hour is attained. The conductors in the gallery are two Vignole rails suspended from porcelain insulators fixed in the roof, and the current is taken off by two traveling carriages fitted with brushes and connected to the locomotive by flexible conductors. The plant efficiency is stated to be 75 per cent.

According to the statistics of an English authority the world's production of fine copper in 1890 amounted to 270,485 tons of 2,240 pounds each. The product of foreign countries was 154,160 tons, and that of the United States 116 325 tons, or 43 per cent. of the world's supply. The total increase in the world's production of copper over 1889 came from the United States. In 1889 the total output was 261,650 tons, of which 105,774 tons, or slightly more than 40 per cent., was from the United States. Chili was the only foreign copper producer that made any considerable increase in 1850. This increase amounted to nearly 2,000 tons more than in 1889, though still not equal to its output in 1888. "As for the future," says the *Engineering and Mining Journal*, "the conclusion to be drawn from these statistics is that the position of copper is secure. The extraordinary demand from the electrical manufacturing companies, which has grown so amazingly during the past decade, is likely to continue at an equally rapidly increasing rate during the present one, as electricity for illuminating purposes, and particularly for the transmission of power, becomes applied to a greater extent."

TELEPHONE.

Shortly after the completion of the London-Paris telephone line the people of the French capital were allowed to make use of the new cable for one day without charge. The Paris correspondent of the London *Standard* says that "The telephonic cabins in communication with London were those at the Bourse and in the Avenue de l'Opera; but there were fewer applicants than might have been expected, and after four o'clock at the Bourse there was not a single demand for communication with London."

TELEGRAPH.

In England the question of linking the coast-guard stations and of connecting isolated lighthouses with the mainland, by telegraph, is being agitated.

The new tariff reducing the price of telegrams in Germany went into force on February 1st and resulted in an increase of 7 per cent. in the total number of telegrams during the month of February.

In the year 1870, when the telegraphs of the United Kingdom were taken by the government, the total revenue was £612,301. Five years later it had risen to £1,533,982; in 1880 it was £1,469 795; in 1885 £1,820,764, and last year it was £2,364,098.

Secretary Beard of the Central & South American Telegraph company says that there is to be no new line from Guatemala city and Quezaltenango to New York, as that ground is already covered. He says that the recently published statement regarding the new submarine cable between Lima in Peru and Valparaiso in Chili is correct. Mr. Beard has a map showing the lines now operated by the company of which he is secretary, with their connections. They run from Galveston, Tex., to Tampico and other places on the eastern coast of Mexico, cross to the western side of Mexico, from which they run southward to various points in Central America and thence further southward along the Peruvian and Chilian coast to Valparaiso, there uniting with the Transandine wires to Buenos Ayres,

from which they advance northward through Brazil beyond Pernambuco. There has been telegraphic communication between Galveston and Buenos Ayres since 1882.

John White Kelly, who, according to a New York dispatch, is the oldest operator employed by the Western Union Telegraph company, is sixty years of age and is still at work in the telegraph office, although he has fallen heir to an estate that will probably bring him the sum of $100,000 in cash. An uncle of Kelly died and made him an heir to considerable real estate. On Saturday last Kelly got his first installment of his fortune in the shape of $16,000 cash. This is not the first time that fortune has smiled kindly upon old man Kelly, Not long ago he made something like $20,000 in Wall street, but he dropped all he had made. This time he hurried to a savings bank. He intends to finish his work in the Western Union service by the end of this month and then retire from active work.

Reports from abroad indicate that the elements have played havoc with the electric wires there as well as in this country. An English paper says: Communication with the continent was interrupted while inland, matters were still worse. On the Cornwall line telegraph wires and poles are so extensively demolished that it will be days before any telegrams can pass. In the Sunderland district the lines suffered heavy damage. The *Times*, speaking on the subject of the interruptions, says there is a loud outcry by the public that wires should be placed underground or encased along railways, so as to prevent obstructions to telegraphy by storms, and the danger to trains from wires and poles falling across the railway. Especially is this urgent in the case of naval and military ports.

MISCELLANEOUS.

It is said that the value of the imports of platinum now amounts to $900,000 per annum. The metal has advanced fully 100 per cent. in price in the last 12 months, largely owing to its extensive employment in electrical appliances

The electric welding method of Prof. Thomson has been applied quite as successfully to the work of uniting two pieces of aluminum end to end as to other metals. Wherever it can be introduced, it affords a preferable substitute for soldering.

Citing the experience of the Chicago Arc Light & Power company, the London *Electrical Review* says: "Of the various causes of trouble with underground cables which have been efficiently laid, probably mechanical injury will be found to be the most fruitful."

Engineering, a monthly magazine devoted to industrial progress, has issued its first number. It contains a number of interesting articles, and an excellent line of illustrations. An interesting contribution by Herbert Laws Webb on "A Chat with Europe by Telephone" and an electrical department are features of the first number.

The arrangements for the meeting of chiefs of fire departments at Springfield, Mass., next August promise one of the most interesting conventions held in this country. An admirable list of papers to be read at the meeting of the association has been presented. Captain William Brophy will read a paper on the "Dangers of Electric Light Wires."

Gutta percha is growing scarcer every year. This gum is the most suitable material that can be used for insulating submarine wires, and for many years submarine cable manufacturers have used it almost exclusively. The price has gone up steadily, having more than doubled during the past ten years. The methods employed by the natives of the Malay Archipelago in collecting the gutta are said to be very crude, and, according to the investigations of a recent traveler, have resulted in the gradual extermination of the tree.

The valuable copper wire now employed in street work by electric companies appears to be a great temptation to thieves all over the country, and accounts of arrests for depredations of this character are constantly appearing in the papers. The latest case is reported from Rochester, N. Y., where the Rochester Railway company and the Brush Electric Light company were the sufferers. A large quantity of the wire was sold to a junk dealer, and was discovered in his possession cut into pieces from six inches to a foot in length.

TRADE NEWS.

The Eureka Electric company of New York, has issued a new catalogue showing the Loomis system of arc and incandescent lighting.

The April supplement to the catalogue of the Knapp Electrical Works of Chicago is out. It is devoted to cuts and price lists of the Perkins incandescent lamps.

The new American ammeter and voltmeter described in a recent issue are placed on the market by the Central Electric company. They are put up in a handsome box with a handy carrying strap and present an elegant appearance.

The interior conduit system will be used in the Leiter building, State street, Chicago. This building occupies a half block on State street, from Van Buren to Congress. It is eight stories in height and is being equipped for twelve thousand lights. Habirshaw wire, furnished by the Electrical Supply company, No. 171 Randolph street, Chicago, will be used.

The Engineering Equipment company has become eastern agent for the Habirshaw wires, cables and cores. The Habirshaw flame proof wire is attracting considerable attention, especially as the new underwriters' rules require its use. Now that the India Rubber & Gutta Percha Insulating company, which manufactures exclusively the Habirshaw wires, has secured a new and fine factory at Yonkers, the output of this wire will be increased materially by the facilities afforded by the new works. The Engineering Equipment company's office is in the Central Building, No. 143 Liberty street, New York City, but the stock room for Habirshaw wire and Underwood belts, will be continued at No. 73 Cortlandt street, which has been the temporary office of this new company.

BUSINESS.

The Sioux City Engine Works of Sioux City, Iowa, have installed one of their 150 horse power Corliss engines for the Crane Manufacturing company, Chicago.

The Michigan Auxiliary Fire Alarm company, Detroit, has secured several large contracts. The company has engaged R. E. Relyea, formerly of Kansas City, as electrician.

The Westinghouse Machine company is publishing in the form of advertisements a series of articles giving a brief history of the company's operations, and explaining the several types of engines made by that company.

The Central Electric company has just secured the general western agency for the New York & Ohio company's lamp made at Warren, Ohio. It is known as the Packard lamp and is favorably known among users of incandescent lamps

ELECTRICAL PATENTS.

Issued April 14, 1891.

450,153. Trolley for Electric Railways. Arthur S. Hickley, Richmond, Va.

450,159. Multiple Fuse Cut-out. Arthur W. Jones, Boston, Mass.

450,163. Non Sparking Clamp for Trolley Wires. Charles A. Lieb, New York, N. Y.

450,164. Electric Railway Wire Support. Charles A. Lieb, New York, N. Y.

450,172. Electric Switch for Electric Railways. Frank Mansfield, New York, N. Y.
The invention consists in the novel form of switch and water tight switch box.

450,173. Electric Switch for Electric Railways. Frank Mansfield, New York, N. Y.

450,182. Light Signal System. Bernice J. Noyes, Boston, and Howard F. Eaton, Cambridge, Mass.

450,184. Trolley Device. Alexander Palmros, Lynn, Mass.

450,189. Electric Motor Car. Francis A. Pocock, Scranton, Pa.

450,193. Rail Connection with Supplemental Wire. Charles A. Robinson, La Grange, Ill.

450,206. Mechanism for Carrying Wires through Conduits. Ferdinand A. Wessel, Brooklyn, N. Y.

450,219. Dynamo Electric Machine. William F. Collins, New York, N. Y.

450,221. Instruments for Measuring Electric Currents. Henry H. Cunynghame, Frederich L. Rawson and Otway E. Woodhouse, London, Eng.

450,228. Printing Telegraph. Pliny H. Fisk, New Richland, Minn.

450,239. Non Interference Signal Box. William H. Kirnan, Brooklyn, N. Y.
The invention relates to transmitters of the character generally employed in fire alarm, police or municipal telegraph systems for sending over a circuit a definite signal to indicate the number of the box or station sending the signal, or any other desired information.

450,242. Trolley Wire Support. Charles A. Lieb, New York, N. Y.

450,245. Fire Alarm and Telephone System. Samuel W. Ludlow, Madisonville, Ohio.

450,260 Thermostat. William F. Singer, Carthage, N. Y.

450,272. Telegraph Relay. Robert O. Wickes, Troy, N. Y.

450,285. Galvanic Battery. Walter A. Crowdus, Memphis, Tenn.
The invention consists in the combination, with a battery cell having a metallic trough in its bottom, of a conductor leading from said trough to the exterior, a bath of mercury in said trough, and an electrode with its bottom portion immersed in the mercury, whereby the mercury forms an electric connection between the electrode and the metallic trough.

450,292. Circuit Closer. William C. Johnston, Jr., Lynn, Mass.

450,294. Insulator. Chas. A. Lieb, New York, and Erwin Lavens, Brooklyn, N. Y.

450,304. Art of Making Filaments for Electric Lighting. Silvanus F. Van Choate, Boston, Mass.

450,319. Rheotome. George E. Pragnell, Brooklyn, N. Y.
Claim three is given:
"The combination, with a rheotome or interrupter, of an electro-magnet, an armature therefor, a strip or spring on said armature but insulated therefrom, an electric circuit, and a lever contacting with the strip or spring of the armature at one end and contacting at the other end with the metal of which the armature is formed.

450,354. Porous Cell for Galvanic Batteries. William Burnley, North East, Pa.
Claim two follows:
"The combination, in a porous cell for galvanic batteries, of a shell of pasteboard or wood veneer, cords or other suitable fastenings for securing it together, and a seal or bottom secured in the lower end of said shell, a depolarizing agent filling said shell around said negative electrode, and a seal closing the upper end of said shell."

450,358. Auxiliary Mouth Piece for Telephone. William N. Marcus, Philadelphia, Pa.
The invention consists of a bent tube, to one end of which is fixed a trumpet mouth-piece, the other end being fitted in a friction socket, and by which socket the tube is attached to the transmitter box of telephone by clamp springs.

450,359. Receiving Telephone Support. William N. Marcus, Philadelphia, Pa.

450,367. Insulation of Armatures for Dynamo Electric Machines. Rudolph Eickemeyer, Yonkers, N. Y.
We give the first claim:
"An armature drum or core for dynamo electric machines clothed on its face with an inner layer of narrow insulating material laid diagonally from end to end, and an outer layer of similar material laid diagonally but reversely to the inner layer."

450,384. Electric Wire Insulator. Daniel A. Bertolett, Norristown, Pa.

450,390. Electric Time Call. Richard Varley, Jr., Englewood, N. J.

450,425. Heat Annunciator. A. Reinemann, New York, N. Y.
Claim one is:
"The combination of a yielding closed vessel with a double charge, and a fusible envelope separating the ingredients of the charge."

450,426. Electrical Apparatus for Reproducing Sounds. Jules E. Roulez, Paris, France.

450,441. Automatic Switch for Electric Motors. Fenner E. Whipple, Philadelphia, Pa.
Of the thirteen claims the first is given:
"The combination, in an electrical switch, of a pair of sheaves, a belt passing around the same, and a switch-closing plate carried by said belt.

450,458. Electric Signal Robert H. Gruschow, Chicago, Ill.

450,460. Fender or Safety Attachment for Electric or other Cars. David Hines, Cambridge, Mass.

450,466 Fire Alarm and Telephone System. Samuel W. Ludlow, Madisonville, Ohio.

450,489. Trolley Guide. William E. Jackson, Jr., Augusta, Ga.

450,541. System of Electrical Distribution. Charles J. Van Depoele, Lynn, Mass.
The third claim reads:
"In a system of electrical distribution, a chemical counter electromotive force device in circuit with a source of current, a commutator to the sections of which the elements of the device are connected, and a working circuit composed of one of the main supply conductors of the said device, and a conductor connected to an adjustable contact or contacts upon the commutator thereof, and a distributor and translating device in said working circuit."

450,542. Reciprocating Electric Railway Motor System. Charles J. Van Depoele, Lynn, Mass.
The last claim is given:
"7. A reciprocating electric motor system comprising multiple reciprocating electric engines, direct connections between the moving parts of said engines and a common crank to be driven, a distributor or current generator giving successive currents of defined rising and falling quality, separate circuits between the distributor and the engines, and means for directing the currents from the distributor to the separate engine circuits in succession."

450,543. Electro Magnetic Reciprocating Engine. Charles J. Van Depoele, Lynn, Mass.

450,544. Pulsating Current Electric Motor. Charles J. Van Depoele, Lynn, Mass.
Claim one follows:
"The combination, with a source of continuous and pulsating currents, of a motor having a closed circuited armature encompassed by an inducing coil in circuit with the source of pulsating current and field magnets of constant polarity reacting upon the poles induced in the armature."

450,551. Electric Switch. Frederick Adam and John Knapik, St. Louis, Mo.

450,552. Armature. La Motte C. Atwood, St. Louis, Mo.

450,558. Electric Call Bell and Indicator. William Cox, Toronto, Canada.

450,577. Regulator for Electro Therapeutic Apparatus, John H. Davis, Findlay, Ohio.
The second claim is:
"The combination, with the battery, of the rheostat, consisting of the vertical cylinder adapted to contain water, and the vertically adjustable tube arranged to enter said cylinder.

450,581. Electric Wire Connection. Edward J. Gatley, Rome, N. Y.

450,586. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.
Claim two is given:
"In a branching electric railway, a main line conductor and a branch line conductor extending along the main line and branch tracks, respectively, and electrically connected, in combination with two distantly located generators, one connected to the main line conductor and the other connected to the branch line conductor."

450,587. Electric Wire Supporter. Charles A. Lieb, New York, and Erwin Lavens, Brooklyn, N. Y.

450,589. Holder for Electric Cables. Joseph W. Marsh, Pittsburg, Pa.
The second claim follows:
"The combination, with a cable, of a socket fitting over the ends of the cable, and a clip for attaching the ends of the cable to the spool."

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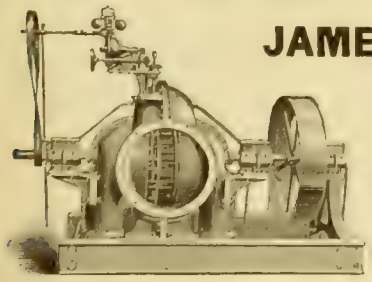

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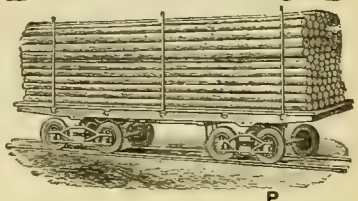

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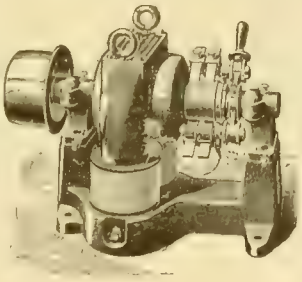

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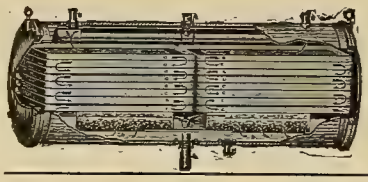

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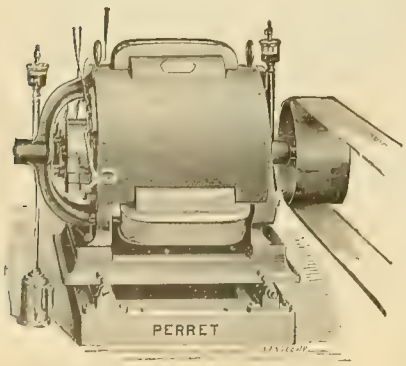

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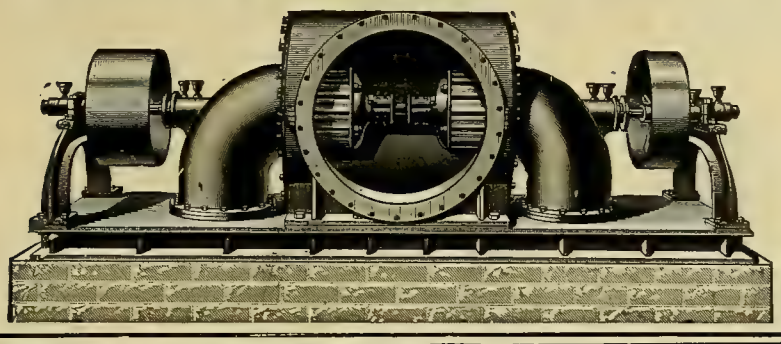

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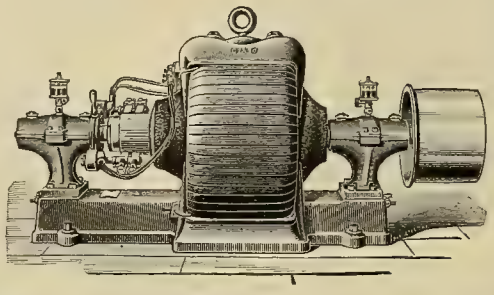

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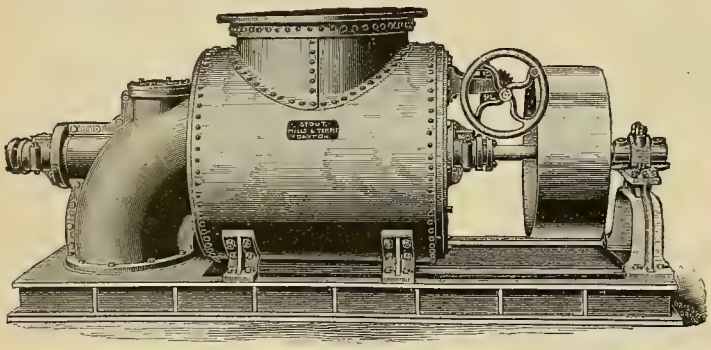

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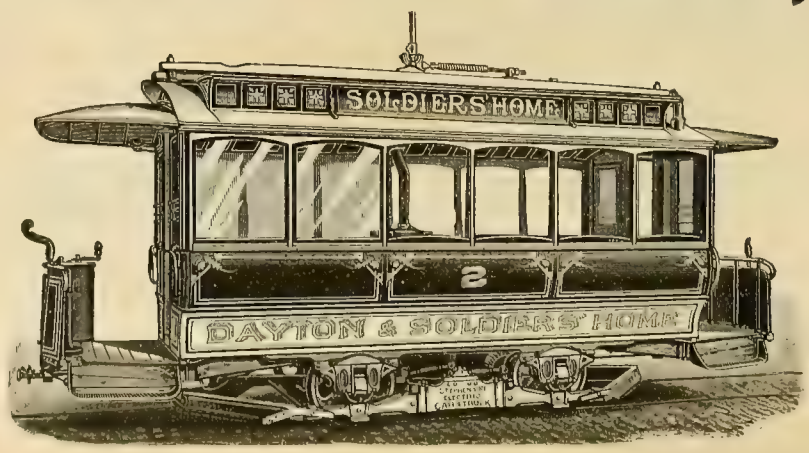

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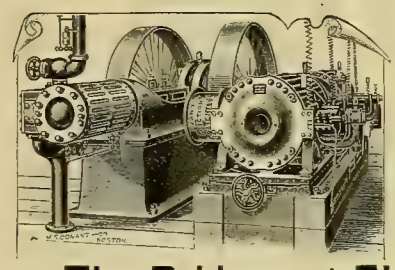
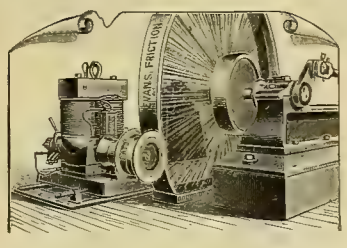
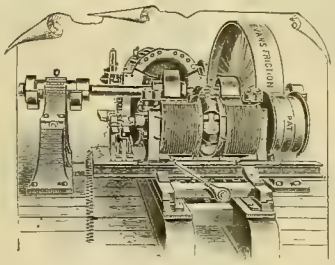
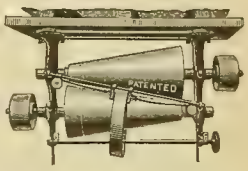

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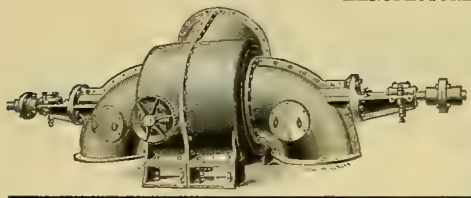

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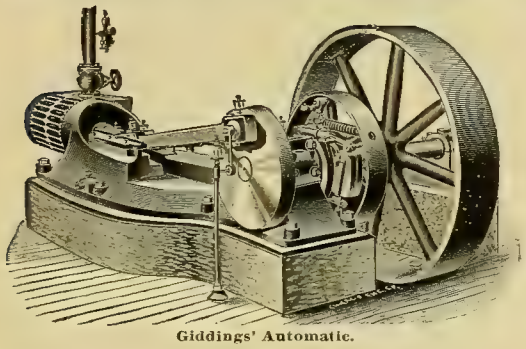

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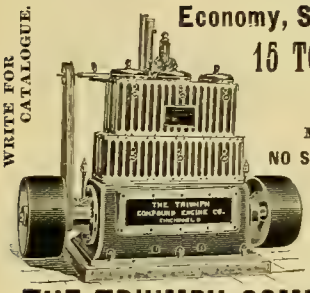

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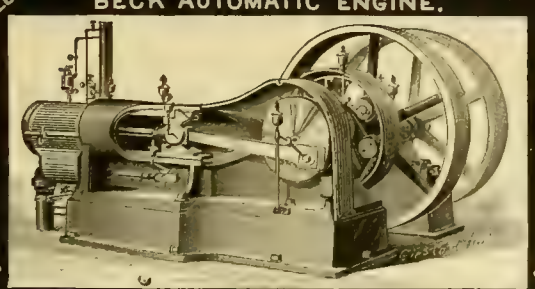

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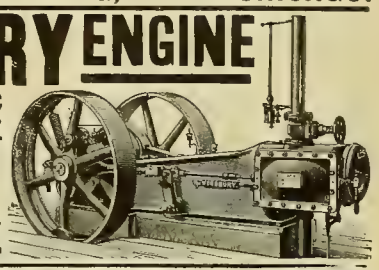

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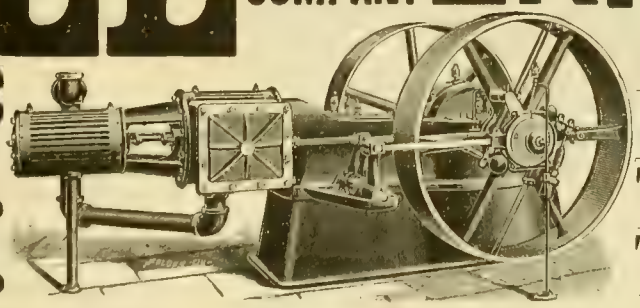
BALL ENGINE COMPANY ERIE, PA.

AUTOMATIC CUT-OFF ENGINE



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Cross Compound.
Triple Expansion.
Tandem Compound

ENGINES for ELECTRIC RAILWAY and ELECTRIC LIGHTING.
The only GOVERNOR giving ABSOLUTELY the Same Speed under all CHANGES OF LOAD or BOILER PRESSURE.

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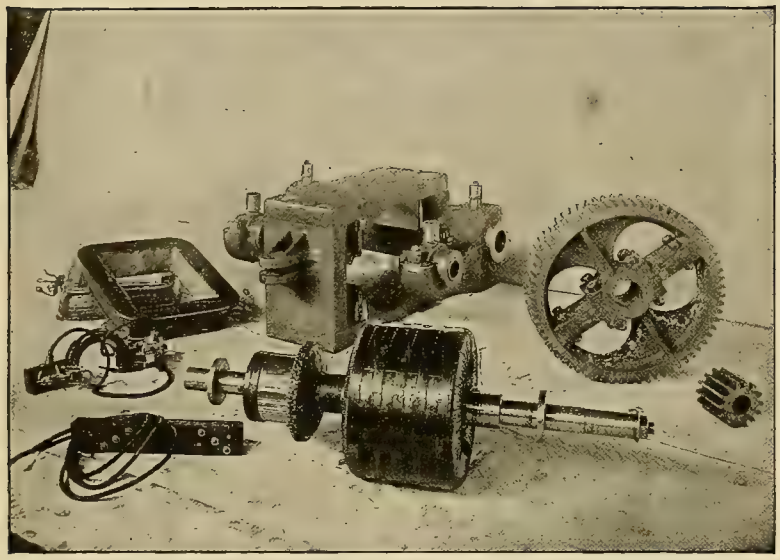
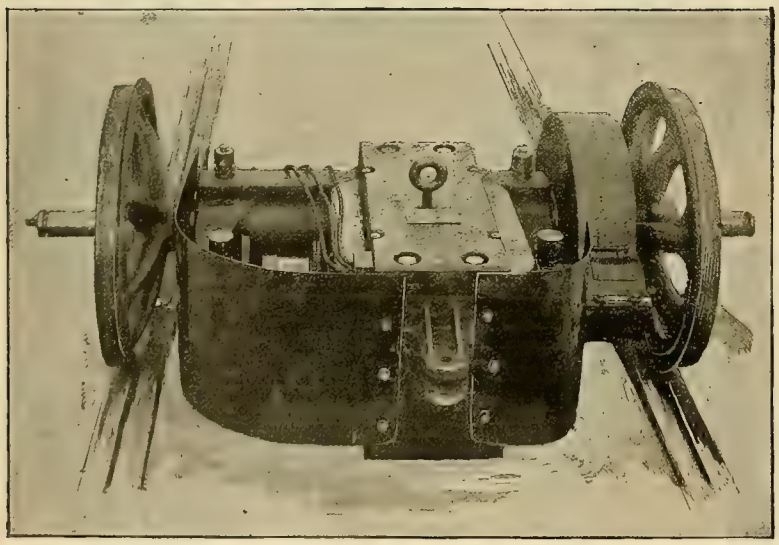
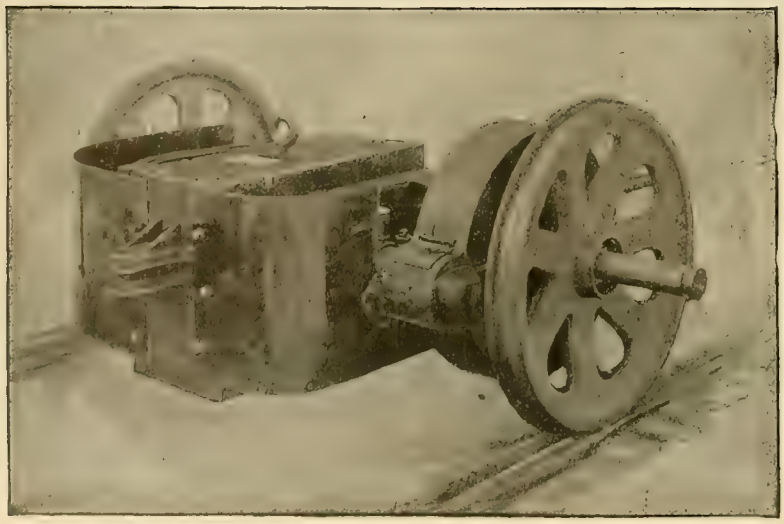
Has Revolutionized the Electrical Equipment of Street Railways.







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Reducing to a minimum the cost for repairs and absolutely eliminating the objectionable noises incident to all other systems.

The Armature speed has been reduced from 1200 to 500 revolutions per minute.

The Railway Motor, as now constructed, comprises less than a dozen parts.

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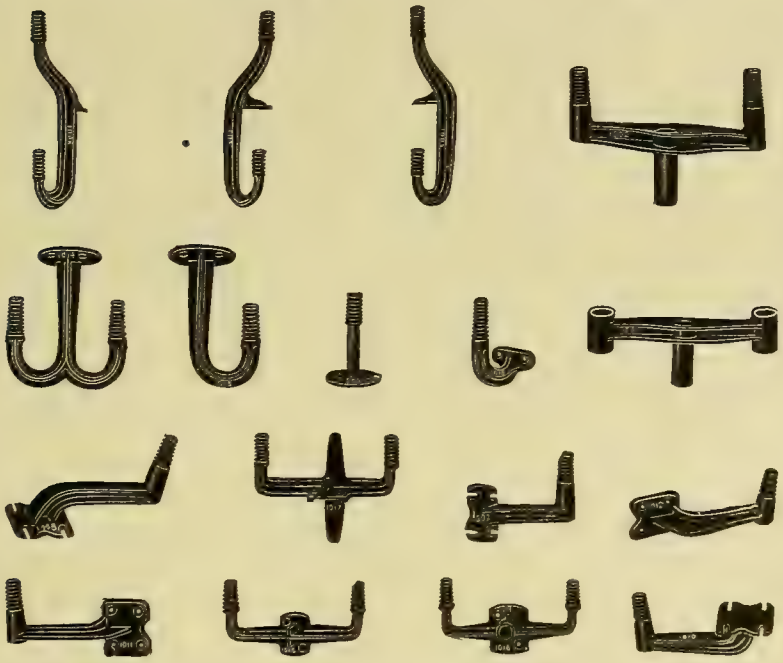
GENERAL WESTERN AGENTS.

PERKINS ELECTRIC LAMP CO.

Lamps to Fit any Socket. Any Candle Power.
Highest Efficiency.

HIGH INSULATION BRACKETS.



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Overhead Railway Switch.

RAILWAY SUPPLIES
OF EVERY DESCRIPTION.

The Diamond "K" Splicing Torch.

GRIMSHAW WHITE CORE

WIRES AND CABLES.

CHICAGO INSULATED WIRE COMPANY'S

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OUR CATALOGUE FOR '91 JUST OUT.

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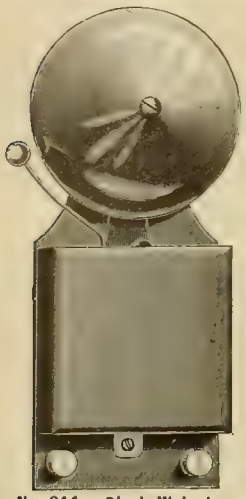

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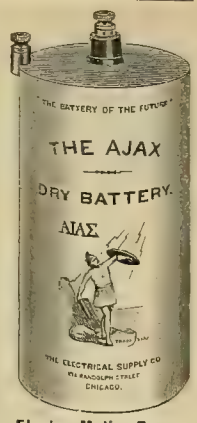
171 RANDOLPH ST.
CHICAGO.

GENERAL WESTERN SELLING AGENTS

—FOR THE—

EDISON-LALANDE BATTERY.



Electro-Motive Force, 1½ Volts. Internal Resistance, .5 Ohms.

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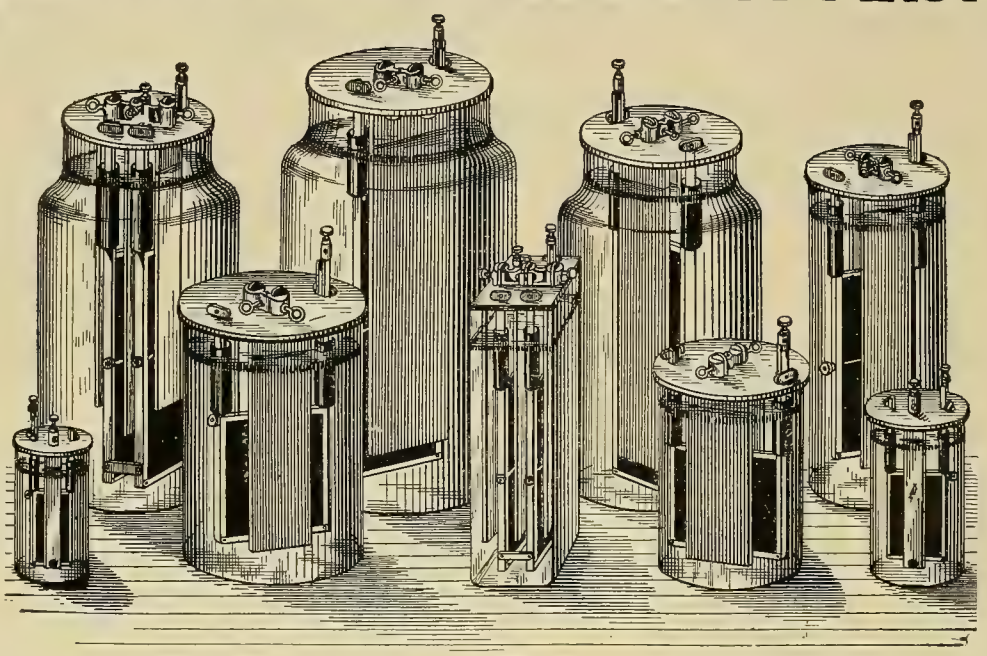
Iron or Wood Box, 2½ or 3 inch Gong.



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TYPE E. 150 Ampere-hour, Small Telegraph Model.
TYPE G. 300 Ampere-hour, W. U. Telegraph Model.
TYPE K. 300 Ampere-hour, Phonograph Model.
TYPE M. 600 Ampere-hour, Motor Model.
TYPE P. 600 Ampere-hour, Elect. Lighting Model.
TYPE T. 900 Ampere-hour, Elect. Lighting Model.
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AJAX DRY BATTERY

For Electric Bells.

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THE CARDINAL VIRTUES

IN FAVOR OF THESE BATTERIES ARE:

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2d. No chemical action and consequent loss of material while the cell is idle. (Less than ½ of 1 per cent.)

3d. Extremely low internal resistance (.025 of an ohm.)

4th. Cheap materials easily obtained.

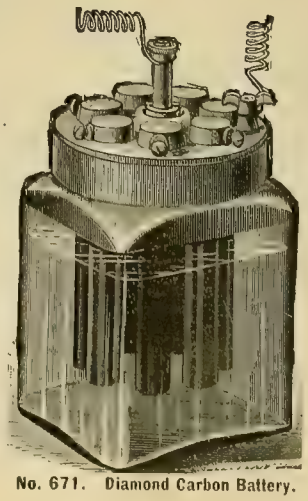
5th. No attention or inspection required until all the energy of its elements is exhausted.

6th. Convenience of form and freedom from noxious fumes or chemical deposits.

7th. No other battery so nearly fills all the above conditions as the EDISON-LALANDE.

8th. The EDISON-LALANDE is made in 9 different types, each one of which is especially designed for the kind of work named.

No. 641. Iron Box.



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DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive, and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush invention.

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ALTERNATING CURRENT APPARATUS.
INCANDESCENT LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING,
ETC, ETC, ETC.

THE BRUSH ELECTRIC CO.,

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FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction and Wood Arc System

OF

Electric Lighting.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM,

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Useful and economical for all purposes to which electricity is applicable, such as

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Only Clean and Convenient Battery for Surgeons, Dentists, and Professional Men Generally.

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COMPLETE ELECTRIC LIGHT AND POWER PLANTS.

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RAILWAY MOTORS,

SLOW SPEED.
NO INTERMEDIATE GEARING.
GEARS RUN IN OIL.

EXAMINE INTO THE MERITS OF THESE MOTORS
IF A *REDUCTION IN REPAIRS* IS WORTHY OF CONSIDERATION.

COMPLETE Railway and Power Plant EQUIPMENTS.

SLOW SPEED STATIONARY MOTORS For ARC and Incandescent Circuits.

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Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. VIII. CHICAGO, MAY 2, 1891. No. 18

Ireson's Self-Adjusting Leather-Link Belting.

Patd. Nov. 16, '86.

Especially adapted for all Electric purposes and other high-speed machinery.

Send for Ireson's Illustrated Treatise on Self-Adjusting Leather Link Belting, furnished gratuitously.

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EVERYTHING ELECTRICAL.

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ELECTRICITY IS LIFE.

At least it furnishes a livelihood to those

Who Know a Good Thing, and They Are the Buyers of Our

CELEBRATED INSULATED WIRES AND CABLES.

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Nuttall Trolley. Patents Pending.

THE BEST!

$30.00

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ENGINEERING EQUIPMENT COMPANY

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☞ Stock room for the Underwood Mfg. Co. belts continued at 73 Cortlandt Street.

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INSULATED WIRES AND CABLES,

For Aerial, Submarine and Underground Use.

Candee Aerial Wires.
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Okonite Waterproof Tape.

OKONITE TRADE MARK

BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco.

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See Page XXVI.

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DAYS KERITE

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ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

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Western Electric Co., Chicago, Ill., Sole Agents for the West.

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WRITE US FOR PRICES OF ALL GOODS.

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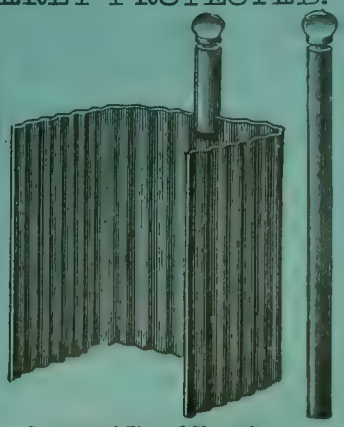
Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.

THE TRADE WILL BE PROPERLY PROTECTED.

Complete Cell of Champion Battery.

Carbon Reservoir and Cover of Champion Battery.



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Rod Zinc of Champion Battery.

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Electrical Supplies

OF ALL DESCRIPTION.

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STANDARD ELECTRICAL MEASUREMENT APPARATUS.

NOTE THE CONTRAST!!

INCANDESCENT LIGHTS

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4,150	VERMONT,	2,200
12,800	TENNESSEE,	1,485
1,500	SOUTH CAROLINA,	NONE.
18,450	TOTAL,	3,685

FIVE TIMES as many of the Thomson-Houston System as of

ALL OTHERS COMBINED.

The figures referring to "total of all systems," taken from table published in August number of "Electrical Industries," for year 1890, are of undisputed accuracy.	Total of all systems.	Thomson-Houston System.	
		Number.	Percentage to total of all systems.
Vermont, - - - -	6,350	4,150	$65\frac{3}{10}$ per cent.
Tennessee, - - - -	14,285	12,800	$89\frac{1}{2}$ per cent.
South Carolina, - -	1,500	1,500	100 per cent.

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831 New York Life Building, Kansas City, Mo.

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405 Sibley Street, St. Paul, Minn.
215 West Fourth Street, Cincinnati, O.
1110 Noble Street, Philadelphia, Pa.
1333 F Street, Washington, D. C.
115 North 3d Street, St. Louis, Mo.

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Cleveland Aluminum Co.

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Turner Brass Works.

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Brush Electric Co.
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Electric Construction & Supply Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
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Batteries.
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Hay Mfg. Co., Walter.
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Monitor Electric Co.
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Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Wollensak, J. F.
Western Electric Co.

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Empire City Electric Co.
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Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Electrical Works.

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(See Wire Insulated.)

Cable, Electric. (See Wire Insulated), **Copper, Sheet and Bar.**
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Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Stephenson Co., John.

Clutches, Friction.
Hill Clutch Works.

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Electrical Construction Co., The.
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McLaughlin, Jas.
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Roebling's Sons Co., Jno. A.
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Holmes, C. H.
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Empire City Electric Co.
Fletcher & Fletcher Electric Co.
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Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Paiste, H.T.
Partrick & Carter Co.
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Star Electrix Co.
Union Hardware Co.
Van Nuis, C. S.
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Bain Electric Mfg. Co.
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Easton Electric Co.
Electrical Engineering Co.
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Thomson-Houston Electric Co.
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Western Electric Co.
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Fletcher & Fletcher Electric Co.
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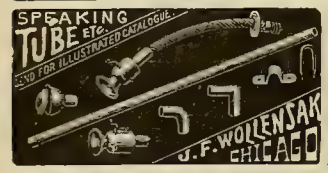

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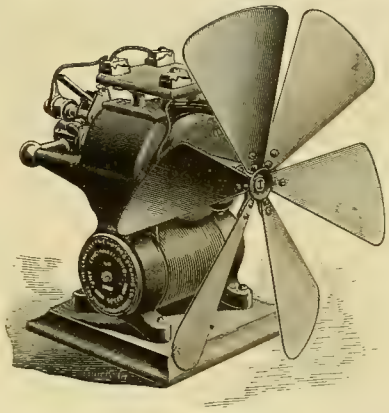

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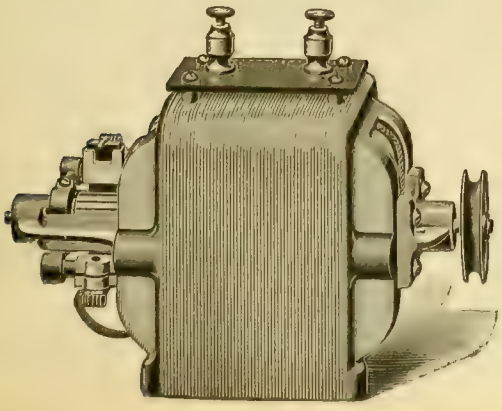

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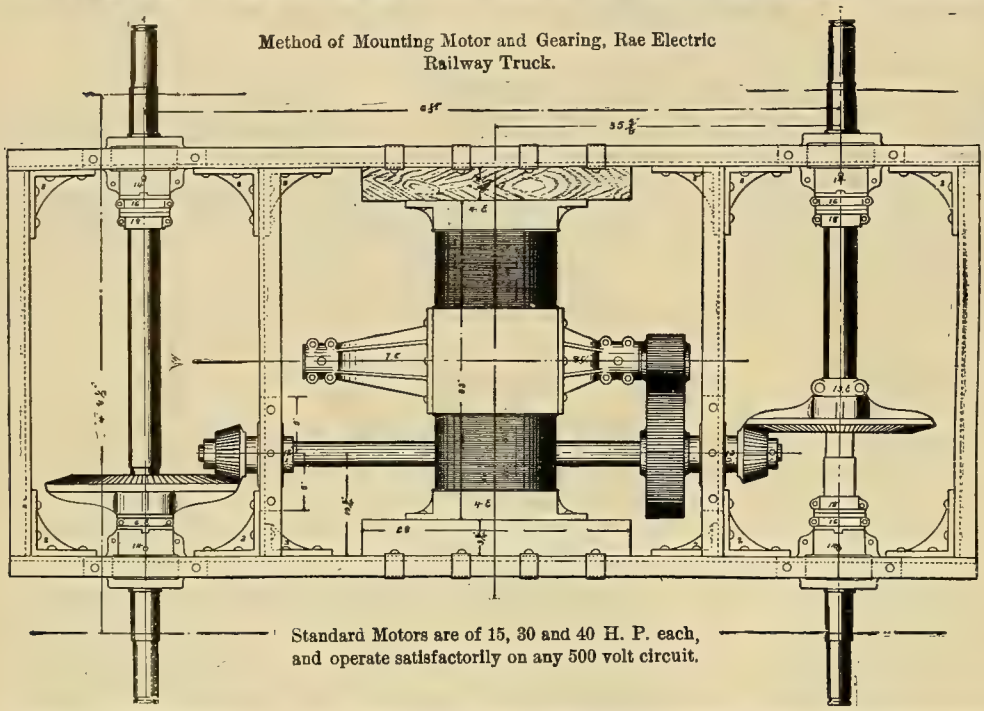

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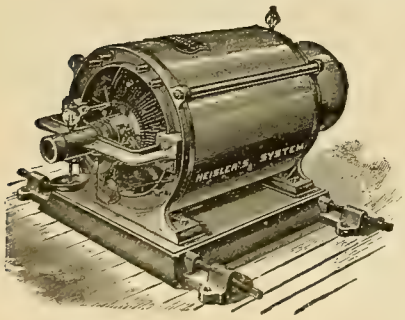

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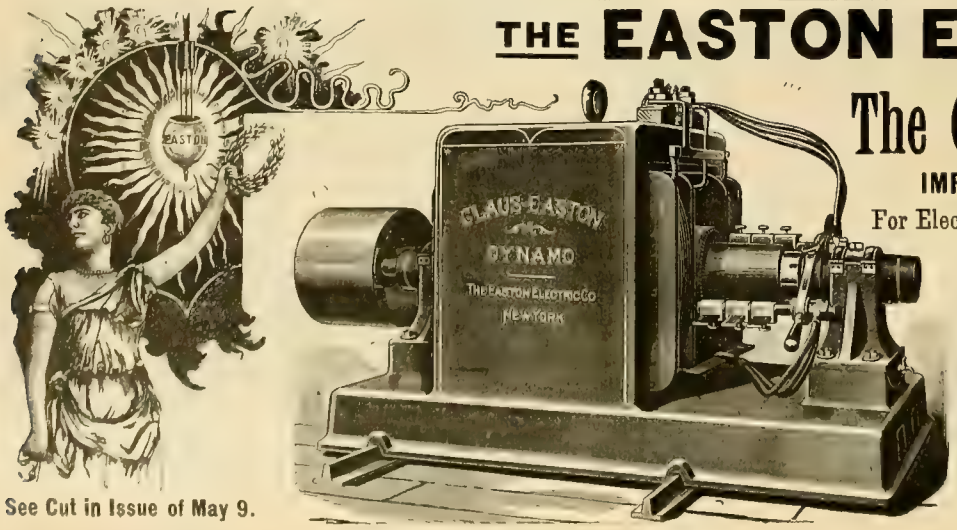

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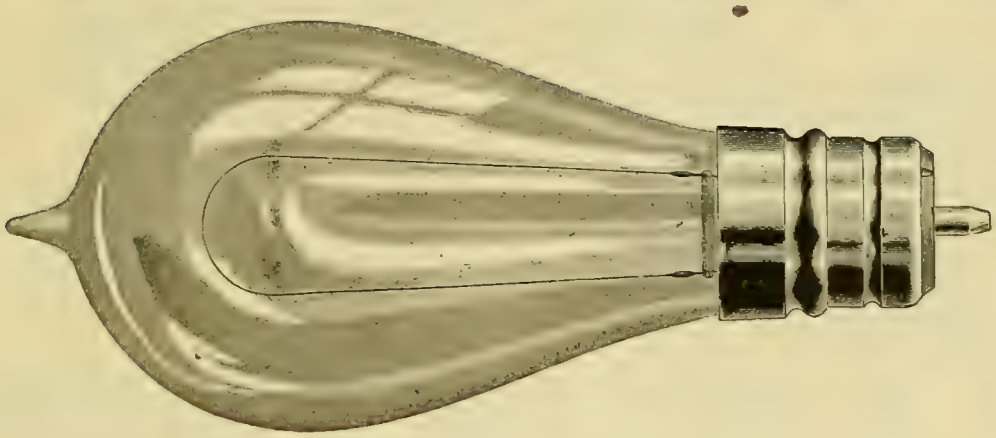

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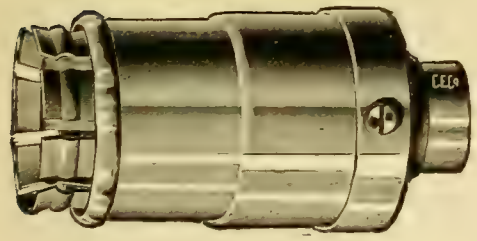

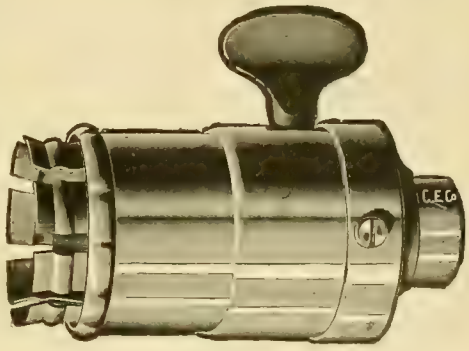

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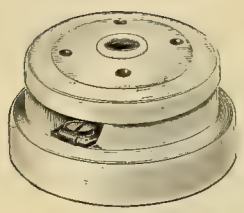

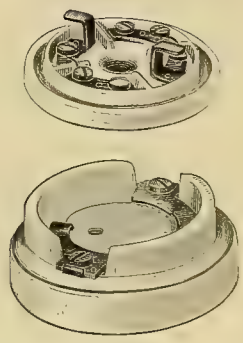

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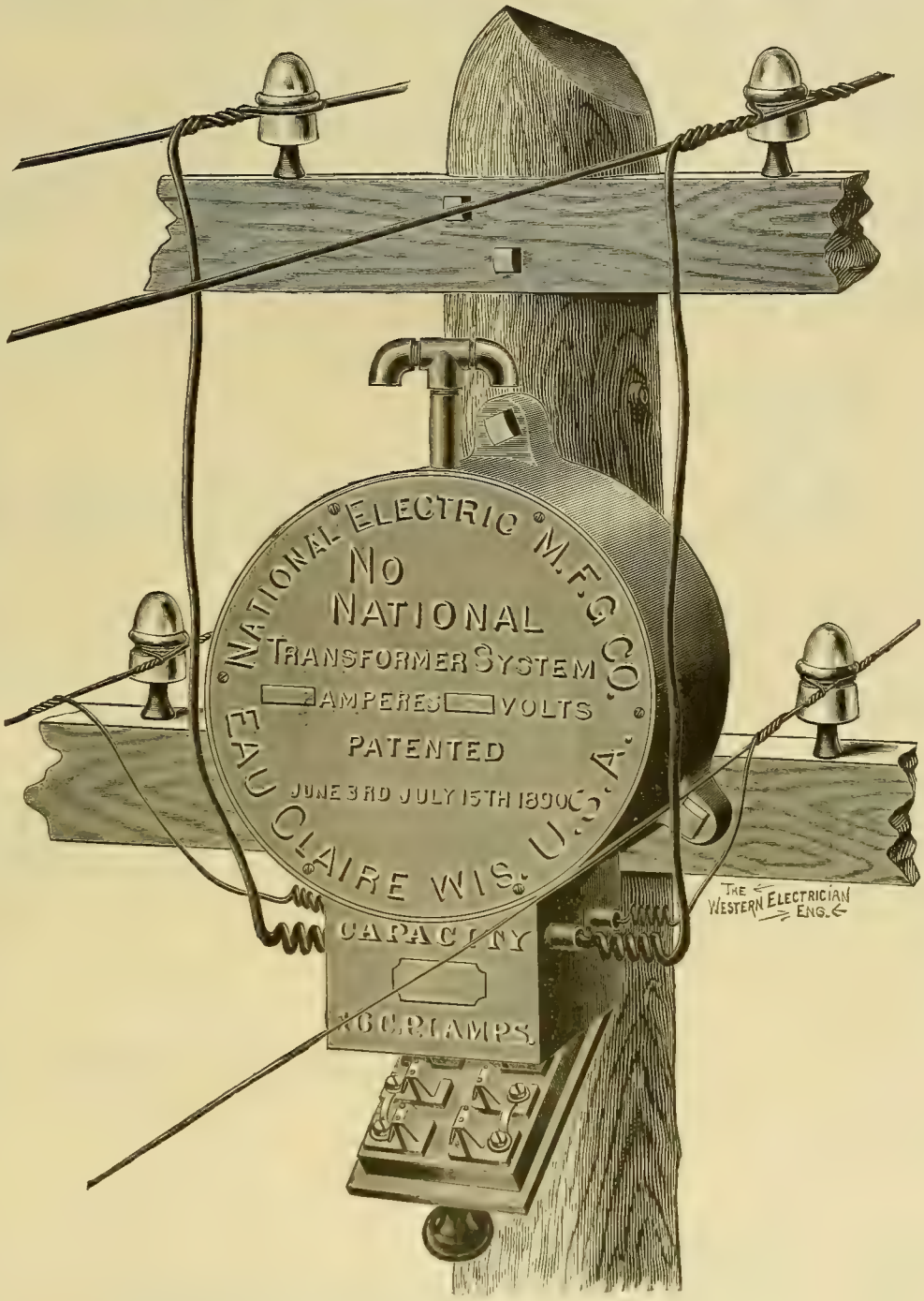

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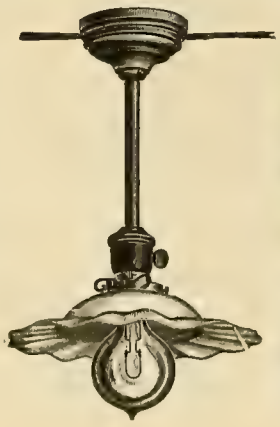

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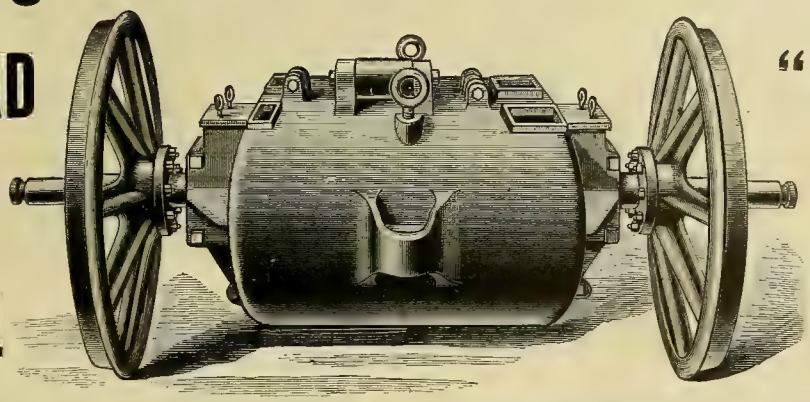

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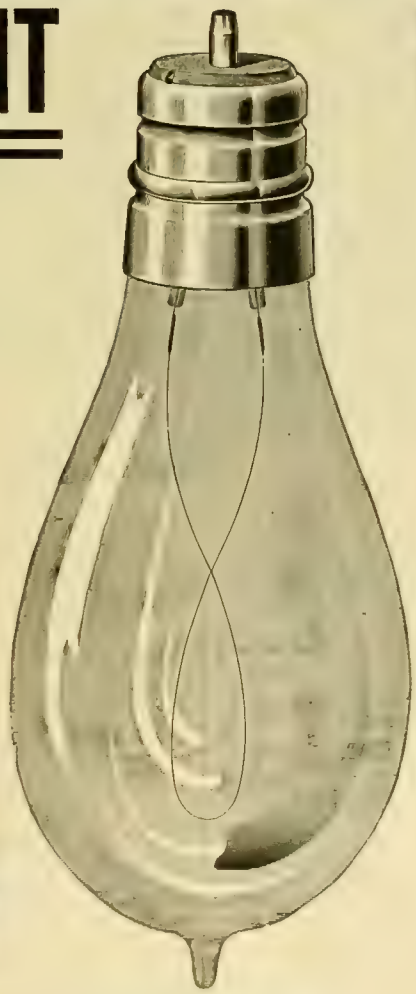

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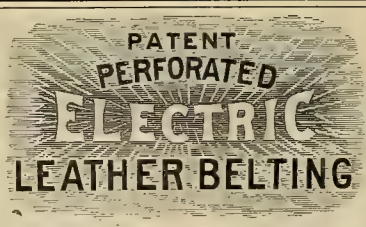

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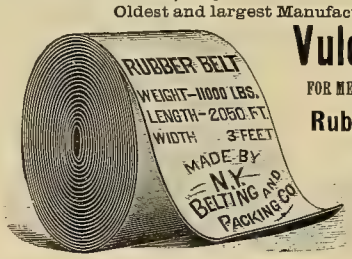

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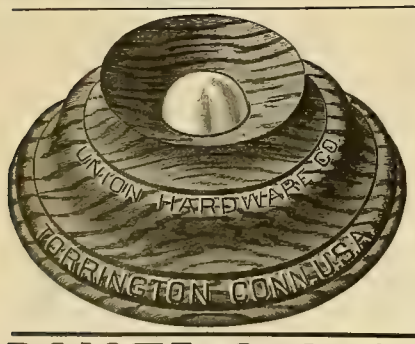

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Vol. VIII. CHICAGO, MAY 2, 1891. No 18

Laying the Underground Conductors of the Minneapolis Electric Street Railway.

The electric system of the Minneapolis Street Railway company is one of the most extensive in the United States; in fact there is no question that Boston and Minneapolis lead the world in this respect. The systems of St. Paul and Minneapolis should be considered as one, as a car from any point in either city may reach any point in the other city by a continuous unbroken trip under a trolley wire.

The novelty of the system employed throughout the Twin cities lies in the fact that there is not a wire in sight except the overhead trolley wire. The feeders, mains and track feeders are contained in a conduit underground. The sub-feeders connect from the trolley wire through the hollow iron supporting poles.

The cuts presented herewith are reproductions of photographs taken while the work of laying the underground conductors was in progress.

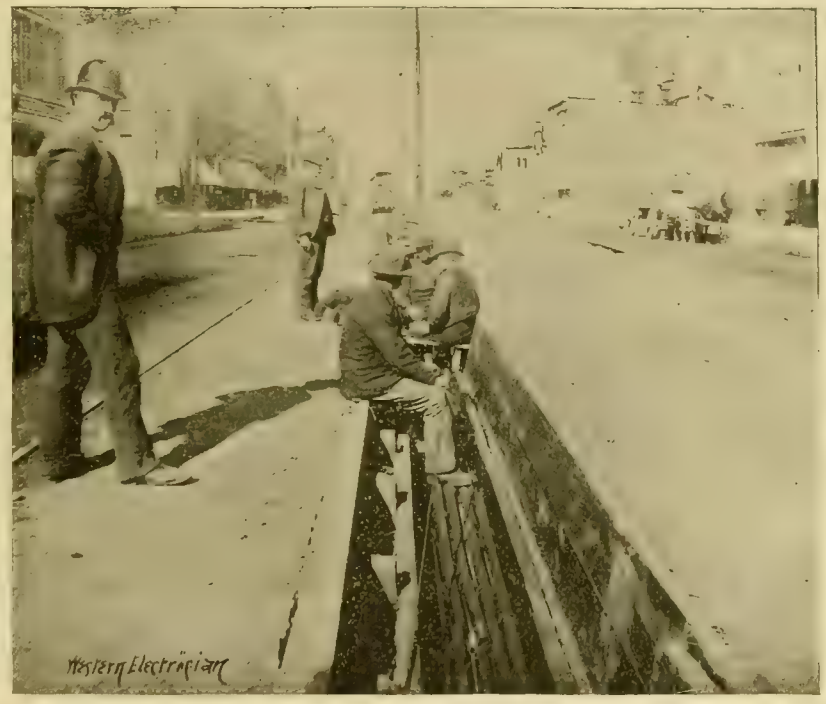
The conduit is located between the tracks of the double line, and is built as follows: Two-inch plank, first treated by boiling in fernoline, is used for constructing a long box or trough of the desired size. This box is laid in a trench and so nailed together as to form a continuous conduit from one man-hole to another, a distance of about 400 feet. The trough is placed below the surface at such a depth that the top of the box is about six inches below the paving blocks. The conduit proper consists of a number of paper tubes of the Interior Conduit company's make.

These pipes are laid in the box in lengths of ten feet and are separated from each other and the sides of the trough by washers placed on the tube at intervals of about two feet. The tubes are made continuous in length by the use of a ferrule and a peculiar cement. The tubes are raised from the bottom of the box by placing at short intervals, cross-pieces made of short lengths of the tubing. The tubes project into each man-hole, and the number of tubes in the boxes is determined by the number of feeders required.

After the tubes have been properly put in place, a vessel filled with pitch, which is kept hot by fire underneath, is wheeled along on one of the railroad trucks and the pitch is caused to flow into the boxes at a certain temperature. It may be mentioned that the success of the system is greatly dependent upon the temperature of the filling. If the pitch is too hot it melts the cement around the joints and runs into the tubes; if it is too cold, the interstices in the boxes will not be filled, and moisture from the outside would penetrate the box. After the pitch has been run in so that every tube is entirely covered, a two inch pine plank top is nailed on and the trench is filled with earth.

The man-hole walls are of wood treated by the same process as that used to prepare the conduit boxes. As will be seen from the illustration, these little vaults are formed of two boxes with a pitch filling between the sides. The outer box is 36x36x36 inches inside measurement, and the inner box is 30x30x30 inches outside measurement. The inner box is thus thoroughly insulated from the outer casing and the ground. An iron cover is provided for the outer box, and the inner box has an iron cap on it, which is sealed tight with a special preparation of pitch, cement, etc. In the top of the inner box there is a hole about 1½ inches in diameter, which is filled by a screw plug. The object of this hole is to admit a small pump which is used by the inspector to remove any water which may collect.

A rather bold experiment was made at Minneapolis, which consisted in drawing uncovered copper cables into the conduit tubes. After the tubes had been laid in place there arose the problem as to how the cables were to be drawn through the tubes. One of the illustrations shows how this difficulty was overcome. A large fisherman's reel was placed in a case which was attached by flexible tubing, as shown, to a blower. To one end of a line wound on the fish reel, there was attached the thumb of a glove. This little bag was inserted in the tube and the point of the case was placed in after it. With two men at the blower the glove thumb was blown through the tube, carrying the cord a distance of 400 feet in less than fifteen seconds. Heavy cord was then tied to the string and the finer cord was again wound upon the reel which was then ready for a similar operation. To the heavy cord was attached a steel cable and by means of this the copper conductors were reeled off of the large spools and drawn into the tubes. In some cases conductors of 350,000 circular mils were drawn into the tubes in lengths of 1,500 feet. Smaller conductors were drawn into the tubes in lengths of 3,000 to 5,000 feet.



LAYING THE UNDERGROUND CONDUCTORS OF THE MINNEAPOLIS ELECTRIC STREET RAILWAY.

It is estimated that as much as 250 miles of uncovered copper cable are now resting in the conduit. The insulation resistance on the entire amount of tubing is 35,000 ohms. A large amount of this conduit has been in operation, it is stated, since the 1st of October without any trouble arising from it.

In the Minneapolis system iron poles between the tracks are used entirely. Sub-feeders come out of the conduit, pass up through these hollow iron poles, and are connected to the trolley wires through fuses at intervals of 400 feet, or at every man-hole.

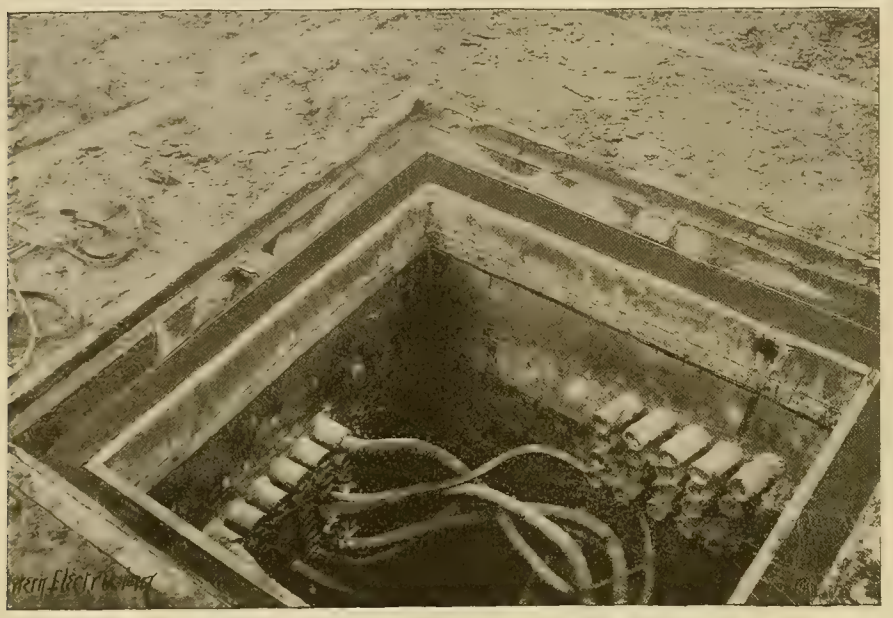
When the Minneapolis system is fully equipped it will include more than one hundred and forty miles of track, and two hundred electric cars will be in operation. The St. Paul system will differ from that of Minneapolis in two very important features. A combination of underground lead cables and overhead construction will be used, and side poles will be employed instead of center poles. There will be ninety miles of track and one hundred and forty electric cars in operation when the system is completed.

The details of construction of both the systems were worked out by Clift Wise, mechanical engineer in charge, and Consulting Electrical Engineer Foree Bain, of Chicago.

Anglo-French Telephone Cable.

The English papers continue to publish extended references to the new Anglo-French telephone cable line. The price charged for a three minutes' conversation between London and Paris—eight shillings, or $2—is considered rather high, especially for press service. On this question a Belgian journalist writes: "The *Independance Belge* employs the Paris-Brussels telephone for sixty minutes every day regularly, and on important occasions for double that duration. Most leading Continental journals do the same, so that if the rate of the London-Paris telephone were available by its moderation, it would be a paying concern for the postal authorities at once, whereas at the present price it will remain almost completely unused. Another interesting fact is that whereas Belgium is connected with the London-Paris telephone through the Brussels-Paris line, it is further connected with Germany by a telephonic line running to the frontier at Herbesthal. Germany, as well as France and Belgium, would be a customer of the cable, therefore, were it not for these forbidding prices, which become increased still further in the Belgian or German cases, seeing that if, for instance, a German paper were to take twenty minutes' communication in London for Paris, it would have to take and pay for another twenty minutes to transmit the news from Paris to Brussels, and then a further twenty minutes to transmit it from Brussels to Herbesthal. I be-

lieve also that the French authorities are quite ready to make the price as cheap as possible, if not for the general public, at least for the press, which is the best, because the most regular and permanent, customer of the telephone. The obstacle, therefore, is one especially created by the English authorities. In illustration of this, I may say that in the case of the Brussels-Paris telephone the authorities first satisfy the requirements of the press, and only reserve to the communications of private persons such time as is left free by newspaper conversations."



LAYING UNDERGROUND CONDUCTORS FOR THE MINNEAPOLIS ELECTRIC STREET RAILWAY.

Experiments continue to be made in connection with this line. A few days ago London was placed in telephonic communication with Marseilles, a distance of more than 700 miles, and speaking was found to be possible, but far from good. Any small disturbances to which the line is still liable are probably attributable to the method of running the wires on the French side, where a complete twist is effected every six poles instead of every four poles, as in England, so that there is considerable want of symmetry.

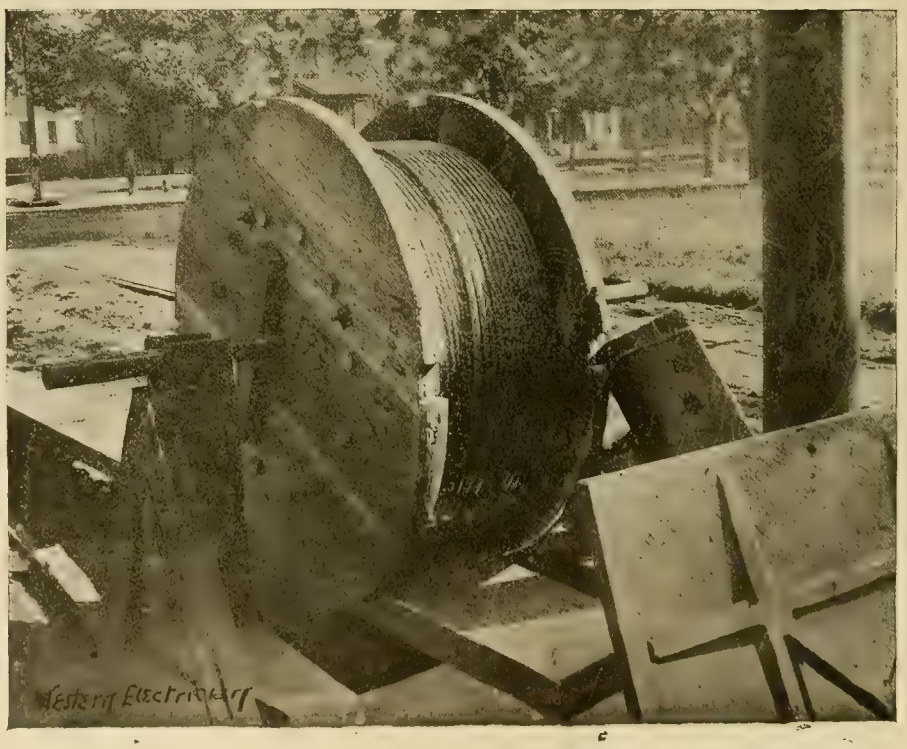
Electric Light Station in Guatemala.

H. H. Morehouse, a graduate of Cornell University in the class of '89, and now electrician at the electric light station at Quezaltenango, Guatemala, has written an interesting description of the plant in that queer old Spanish town for *The Crank*, a paper published by the technological students at Cornell University. Mr. Morehouse says:

"In these tropical countries, you must understand, coal is absolutely an unknown article, and as firewood at this altitude of 8,000 feet is very expensive, water power was the only choice left, to get a suitable supply of which the plant was located some seven miles distant, necessitating the use of either series or alternating incandescent lighting.

"The plant itself is sheltered in a long, capacious building, constructed, after the manner of the country, of adobe, with stone foundations and a corrugated iron roof. It is only of one story, even this being rather too high, as certain recent severe earthquakes verified. The stream which furnishes the water is a turbulent mountain torrent, and the mill-race is led directly from its course at a convenient bend in the bank, thus doing away entirely with the necessity of a dam. This mill-race is fully a quarter of a mile long, supplied at various points with flood-gates, screens and skimmers, all of which are very essential owing to the great quantity of floating pumice stone, so destructive to the turbine if allowed to get through. At the end of the race a massive head gate leads the water into a three-foot iron pipe, over one hundred feet in length, causing a fall of some twenty feet to the 200 horse power Leffel turbine, where this enormous latent energy is partially converted into rotary motion on a long line of shafting at foot pulleys fitted with Hill clutches and traversed by oak leather belting transmit the power to the armature shafts, which make 1,200 revolutions.

"These machines are all of the Ball four ampere, 70-800 candle power arc light pattern. At present we have only three running, but expect soon to have three or four more, since the dynamos and shafting are all here waiting to be put up. In these machines, it is true, there is no attempt even at an automatic regulator, which is sadly needed and causes much extra care, especially on the incandescent circuits, where the load is ever varying. On the street arc circuits this omission, of course, is not felt.



LAYING UNDERGROUND CONDUCTORS FOR THE MINNEAPOLIS ELECTRIC STREET RAILWAY.

"Next in order come the feeders or main lines to town. These are all of number six underwriter's wire and wind here and there, wherever they can gain a fair foothold through deep gulches, now along the rough, rocky and extremely crooked mountain highway, next a goodly stretch through a pleasant peaceful valley, when comes a long and gradual climb, followed by a precipitous jump over an intervening spur, whereby they get a long start on the highway, and finally, a gentle sweep through a few corn fields and the suburban streets brings all to the town station, labeled with an imposing metal sign 'Alumbrado Electric.'

"The station is a neat little building of two stories, the upper part being frame with iron roof, a pleasing deviation from the monotonous, massive mud and stone structures topped with heavy half cylindrical brick tiles, the universal style of architecture of these parts. From this station the town circuits start off to wander all through the crooked and narrow streets, pausing a moment now and then at convenient corners and turns, leaving at each such way station a vivid sample of their illuminating properties. The street lamps are suspended from neat and simple iron brackets built into the house walls, fitted with reels and balances, by which they are lowered to within a foot or so of the street for trimming, or raised to a height of 15 or 20 feet for illumination, it being impracticable to disturb the lamp at all without the trimmers' ladder and crank key. At present we have only 100 street lights, but large extensions which are already in progress will soon allow fifty more corners to be lighted, as well as to increase the incandescent supply from 250, its approximate present number, to 1,000.

"Probably the most striking sight here to an electrician would be the method of running our street circuits, as until now no poles or other carrying devices whatever have been used, all the wires being attached to the roof timbers or side walls of houses, whichever proved the more convenient, and this obviously often brought the wires dangerously near passers by. It is really wonderful that there have never been any accidents, and although I can hardly wish for them, still a few moderate shocks once in a while would undoubtedly be a good thing in raising the natives' veneration for the company and its accessories. Now, however, we are providing a strong wooden bracket, which is built into the house walls and bolted to the eave timbers, supplied with a cross arm above for carrying four, six or more wires, as is desired. This throws all the wires two or three feet above the house-eaves, where they are well out of the way, a vast improvement, to say the least."

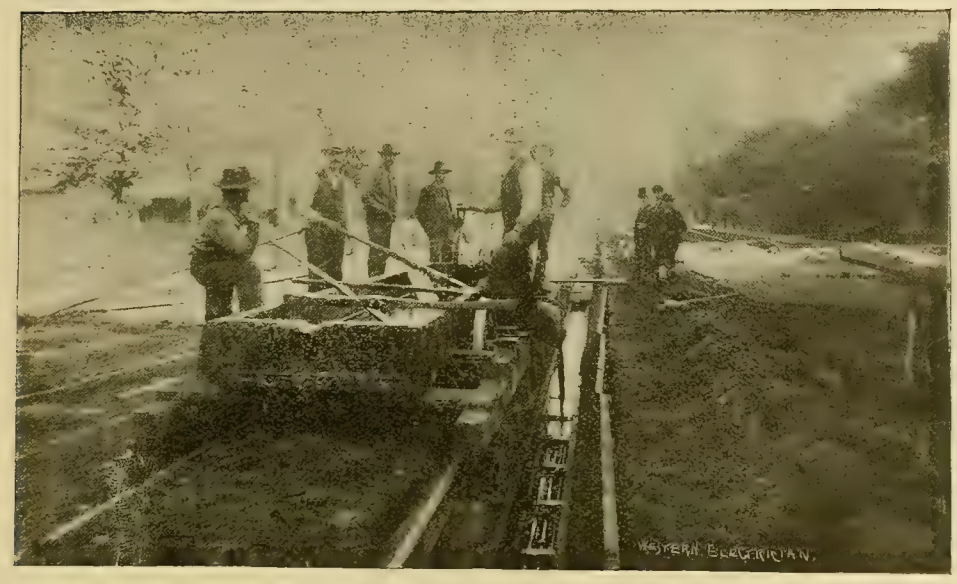
Postal Telegraph Office, San Francisco.

The Pacific Postal Telegraph company's new San Francisco office on Market street, between Sansome and Montgomery, is very complete. In the basement the space occupied by the supply room alone amounts to over 1,000 square feet. In the extreme rear portion is the battery department, containing over 2,000 cells.

The basement contains also, in the supply department, hundreds of miles of wire and other material.

On the main floor is the telegraph office proper. The oper-

ating room is behind the receiving and delivery department and occupies a space of about 1,000 square feet. It is completely equipped with the latest improved instruments. In this equipment is included the quartet type-writing tables. It is said that this office of the Pacific Postal Telegraph company is the only telegraph office in the world that turns out all of its work by this method. The quadruplex and duplex instruments are in constant use. In this room no wires are in sight, as they run down from the poles through iron pipes under the sidewalk into the basement and thence to the batteries and instruments. Back of the operating room are the superintendent's room and book keeper's quarters, and the galleries are used by the clerical force. In front of the operating room, partitioned from it by a glass, is the receiving and delivery department. Everything is fitted up with regard to solidity and lasting qualities, and the furniture is nearly all of heavy antique oak, while the operating tables are of walnut.



LAYING UNDERGROUND CONDUCTORS FOR THE MINNEAPOLIS ELECTRIC STREET RAILWAY.

Electrical Department Demands for the World's Fair.

As the result of the conferences between Professor Barrett, chief of the department of electricity, and Director-General Davis, alluded to in the last number of the WESTERN ELECTRICIAN, the former has prepared and submitted a statement of his reasons for objecting to the proposed building for the department of electricity at the World's Fair and to the division of the exhibits. This communication is addressed to General Davis, and its text is as follows:

I have the honor to report to you that on April 4th last I was definitely advised by the department of construction of the World's Columbian Exposition as to the arrangements going forward in that department for the electrical exhibit at the coming exposition. I am informed by the chief of construction that a building containing 245,000 square feet of floor space and an additional space in a gallery sufficient to increase the total area to 340 000 square feet has been designed for the department exhibit, and that it is contemplated to place a number of electrical exhibits in other departments.

Against this arrangement I beg leave to most firmly but respectfully protest. Such a final determination on the part of the management of the World's Columbian Exposition would prove most disastrous to the electrical exhibit, and would signal the failure of a department that will otherwise make one of the chief attractions of the occasion. Such an arrangement of space is entirely inadequate for a united exhibit of electrical appliances, and a divided exhibit, while leaving abundant space in the presently contemplated building, will so cripple the department that it would be superfluous and a useless expense to set apart for the purpose a building at all.

I am advised from all quarters sufficiently to be able to state that the electrical interests are fully awake to the importance of the occasion, and that no electrical exhibit has ever been planned on the magnificent scale of that contemplated for the Columbian Exposition of 1893. A divided exhibit, however, would either compel exhibitors to make a most ordinary showing in the electrical building proper, or to undertake the maintenance of exhibits in several departments, which would not only be a matter of great expense but would destroy the effect of the whole. Neither of these alternatives are exhibitors willing to choose, and the large majority of them would therefore decline to exhibit at all under such circumstances. Of the groups designed by the department of construction to be removed from the department of electricity, I will cite only one, as I regard that as the only instance affording sufficient argument in favor of the decision to justify any kind of consideration. I refer to the group comprising electric railway systems. It is determined by the department of construction, I am informed, to locate this exhibit in the transportation building and to exploit the systems upon a trial track built around the gallery. I have set out my views as to this exhibit in a letter to the consulting engineer, prepared at his request. I will only add that my understanding of the matter is that there is to be no moving machinery in the transportation building, nor do I in any case see how electric cars could be exploited as a means of transportation, in competition with other means, without at the same time, exploiting all other systems, including steam, cable, etc. This group, moreover, should be especially credited to the electrical department, for in its direction are the greatest achievements of the science, and upon its intricacies the most brilliant minds in the profession are at work.

Without going into the history of electrical expositions heretofore held, I beg leave to suggest that I am well equipped to substantiate the statement that the arrangements for the electrical exhibit presented to me by the department of construction are entirely inadequate and altogether badly advised. The building is so situated that there can be no power but by transmission from a long distance, on account of smoke disturbances, and an electrical exhibit at this day cannot possibly represent the state of the industry without engines, boilers and the adjunct machinery, necessitating boiler-houses and engine-rooms. Even if these could be supplied it will still be impossible without destroying the plot of the exposition by running freight cars about the grounds for hauling fuel. With this showing as to the inadequacy of the present arrangements on the part of the construction department, I beg leave to suggest the following remedy:

There is upon the map of the exposition grounds a circular building, "machinery annex," so called, contemplated to lie within the inclosure made by the terminals of the Illinois Central railroad. This building has not been dedicated to any purpose, but was tacitly set apart for an overflow machinery hall. It has 376,992 square feet of floor space with an additional area of 125,664 square feet in the center, which can be made available. On the outside, at one point, there is a space 130 by 350 feet that would in every way be suited for a boiler house, and still, in addition to this, there is a circular area on the outside of the building and on the inside of the tracks just fitted for the location of the trial track before mentioned. Under any arrangement by which my department could be given this building there would be abundant space for a united electrical exhibit at a point as well chosen as the lay of the grounds would allow, and there would be as well space for the plant necessary to light and furnish power for the exposition.

This communication was at once referred by General Davis to the committee of the directors on electrical appliances, of which Colonel R. C. Clowry is chairman. Speaking about the matter to a representative of the WESTERN ELECTRICIAN, Colonel Clowry said that while he had not examined the plans of the construction department with sufficient attention to warrant an off-hand opinion, he believed that if it were shown that the proposed arrangements were inadequate, the directors would readily agree to any feasible plan to remedy the difficulty. The chairman of the electrical committee was confident that none of the directors desired to antagonize the electrical interests. If the change involved any additional expense, however, he thought the greatest opposition to it would be on a financial basis.

Accompanying the letter to General Davis was a copy of a communication to Engineer Gottlieb on the subject of electric railways. It was dated March 21st, and was as follows:

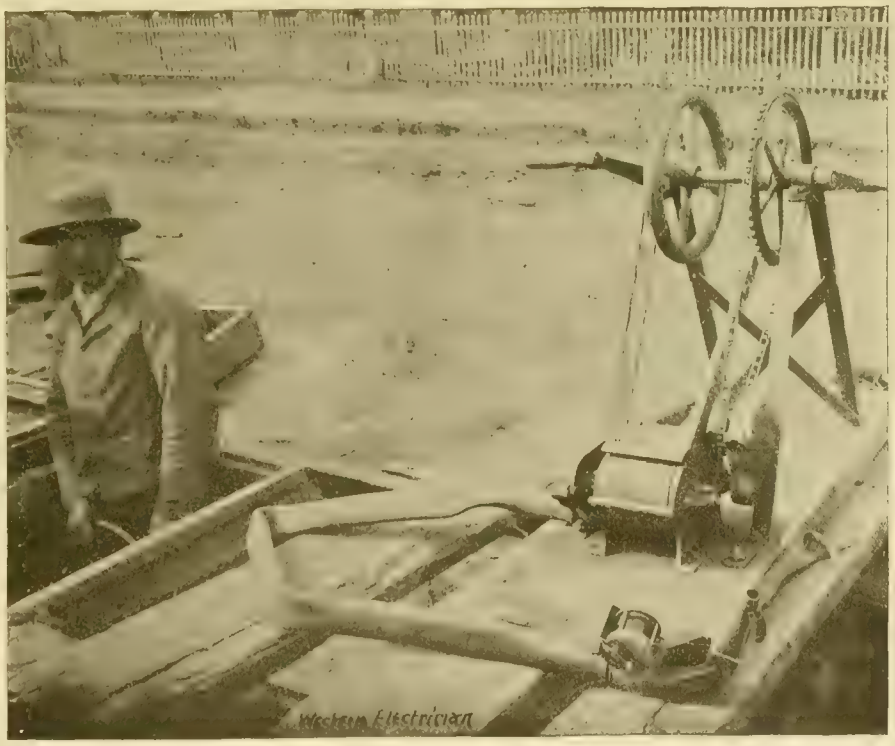
Pursuant to your suggestion, I beg leave to lay before the department of construction of the World's Columbian Exposition one of the prospective requirements of this department for exhibition purposes. A most important factor of the electrical exhibit will be the group comprising electric railway systems. Already a number of applications for space have been received and inquiries made as to facilities for operating the systems to be shown. It will be manifestly impossible to do credit to this important feature of the department without such facilities. This of course means a trial track upon which the exhibits may be exploited. This track should be constructed to meet the following requirements for the reasons assigned:

First.—The track should be in the open air, out of doors, for the reason that the insulation of wires, the loss of current, the action of the atmosphere upon delicate parts of the mechanism, etc., cannot be fairly tested except under the normal circumstances of a working electric railway.

Second.—The track should be oblong, at least one-half mile in length by at least 400 feet in width, with the proper curves to connect these two half mile stretches, because a shorter track than this would not allow satisfactory trials of speed, tests in quick stopping, in reversing, etc.

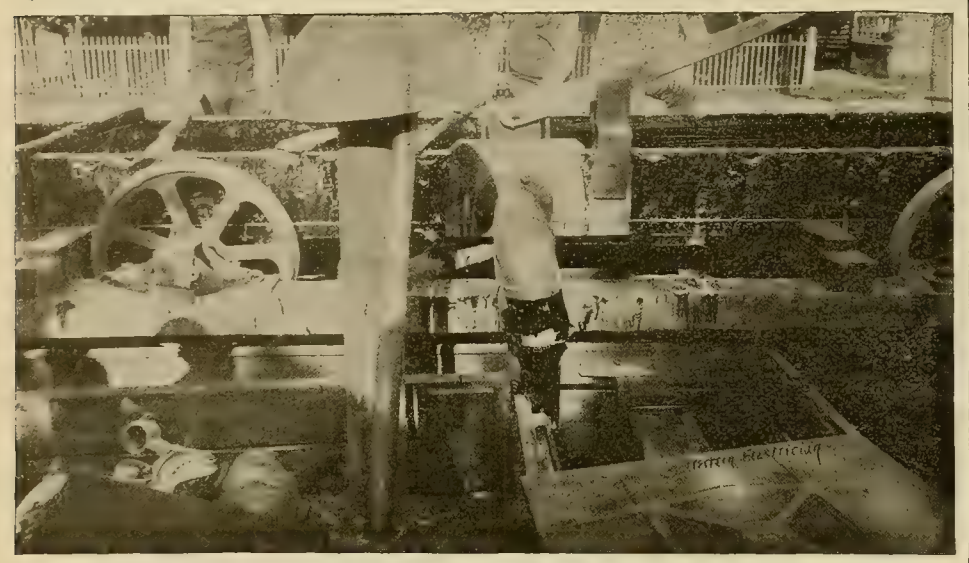
Third.—The track should be upon the surface of the ground, because an elevated way, operating any one of the conduit systems, would not allow a fair test of the insulating power and other features of the conduits, as very much depends upon the effect of the moisture of the earth and the consequent complications.

Fourth.—There should be one slight and one fairly steep



LAYING UNDERGROUND CONDUCTORS FOR THE MINNEAPOLIS ELECTRIC STREET RAILWAY.

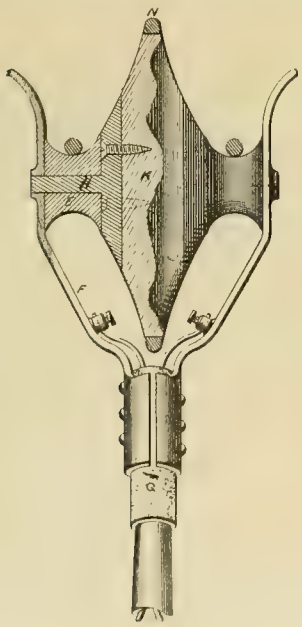
grade. One of these grades should be, say, 300 to 500 feet long with a rise of five feet in the hundred. The other should be of the same length, with a ten foot rise. Both of these grades should be on the same side of the track, thus leaving one clear sweep of half a mile for speeding. Much of the merit of electric roads lies in their adaptability to lines on which are steep grades, and a satisfactory exhibit must include exhaustive tests in this direction.



LAYING UNDERGROUND CONDUCTORS FOR THE MINNEAPOLIS ELECTRIC STREET RAILWAY.

In the construction of this track it will be necessary to observe such general plans as will meet the requirements of the different systems. All the cars can be made of standard gauge, but there must be provision made for a conduit, the specifications to be agreed upon hereafter by the exhibitors in this line of the service. It will be also necessary to contemplate the installation of overhead equipment, if the diverging interests can be reconciled; but this will be a matter also for future consideration, the object being to accommodate as many of the exhibitors as possible.

I trust that it will be possible for the department of construction to arrange for this out-of-door trial track, as



SHORT'S DOUBLE TROLLEY.

I deem it of great importance, especially now when the problem of transportation is in a fair way of solution by means of one or other of these systems. The old as well as the new world is vitally interested in this matter, and such an exhibit, well planned and carried out, will reflect great credit on the exposition and be an object of universal interest.

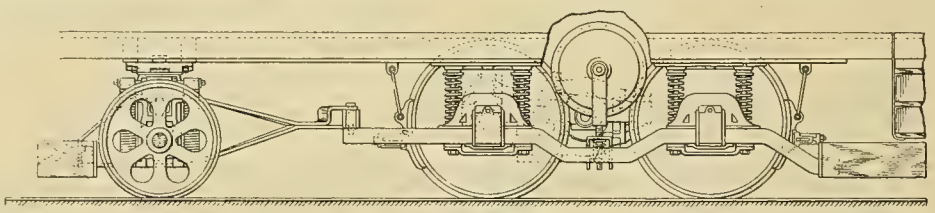
I beg to offer my services and to place the department of electricity at your disposal in this matter, as to plans, specifications, etc. Please call upon me at any time, if I can be of service to you.

"The WESTERN ELECTRICIAN," says the *Pacific Lumberman, Contractor and Electrician*, "is making a hard fight to have the electrical interests at the Columbian Fair at Chicago given a satisfactory building." Yes; that is true. A satisfactory building and a satisfactory arrangement of the exhibits is what the electrical interests want, and what they must have.

Westinghouse Electric Locomotor.

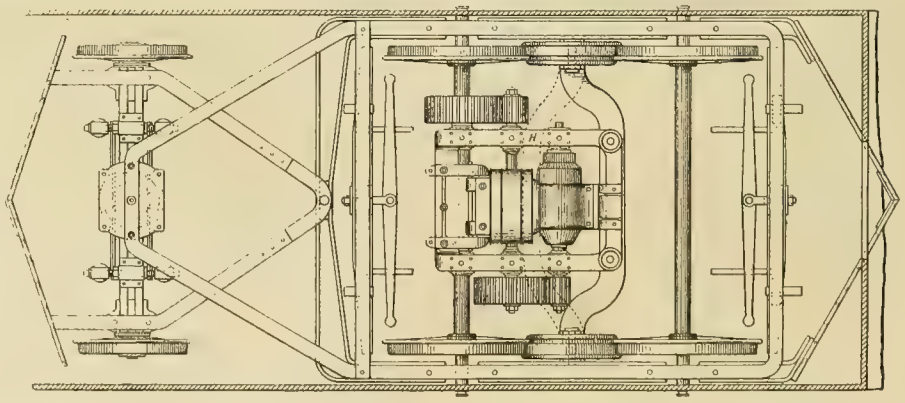
In designing this motor equipment Mr. Westinghouse's object was to secure the requisite friction between the car wheels and track for carrying heavy loads and ascending grades. The car, as can be seen, is constructed with a main truck which receives the greater share of the weight of the car. A pony truck is placed near one end of the car body and serves to steady its movement.

The design of the truck is such that the weight of the car is so distributed that the greatest pressure is normally exerted upon



WESTINGHOUSE ELECTRIC LOCOMOTOR.

the particular pair of main truck wheels to which the driving power is directly applied. The friction between these wheels and the track will be sufficient for carrying ordinary loads. When, however, the motor is called upon to develop the greater power, to carry unusual loads, or to ascend grades, then the second pair of main truck wheels is firmly coupled to the first pair by means of interposed friction wheels. The pressure of these wheels upon the truck wheels is dependent upon and



WESTINGHOUSE ELECTRIC LOCOMOTOR.

determined by the torque exerted by the motor. The friction of both pairs of truck wheels is thus utilized for tractive purposes.

Referring to the cuts it will be seen that the car body is supported upon a frame carried by a main and pony truck. The supporting springs which carry the frame are so adjusted that normally the greater share of the load is carried by the wheels of the main truck.

The motor is carried in a frame which is supported at one end by an axle. The other end of the motor frame is carried by a spring which rests upon a cross-beam. This bar carries at its respective extremities, as shown, two friction wheels. These wheels rest between and run upon the driving wheels of the main truck. The friction wheels are thus at all times pressed downward by reason of the weight of the motor. The amount of pressure necessary to be exerted upon the wheels to prevent them from slipping upon either of the truck wheels will vary with the load being carried. In order, therefore, to utilize the traction of the wheels for propelling the car it becomes necessary to increase the pressure of the friction wheels with an increase of load. This is accomplished as follows: When the motor is driven forward the rotation of the armature tends to thrust the end of the motor downward. This causes not only the weight of the motor, but the additional pressure due to the torque of the armature, to be exerted upon the bar, thus forcing the friction wheels more firmly against the truck wheels.

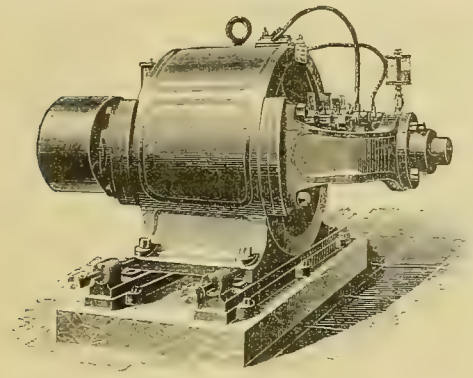
It may be mentioned that the point of support of the wheels with reference to the motor may be changed for varying the amount of effective pressure exerted upon the wheels. Thus the cross bar may be located as shown in the dotted lines. In such a position a greater downward pressure would be exerted under the same load than in the position shown in the full lines.

Short's Double Trolley.

The cut shows a new form of double trolley recently designed by Sidney H. Short of Cleveland, Ohio. In this trolley an intervening disk *K* is provided. This part projects considerably beyond the contacts and is free at the outer edge, so that in applying the trolley to the conductors the projection first enters between the conductors and assists in guiding the contacts into place. While in use it tends to retain the contacts in position and prevent them from leaving the conductors. As shown, the part *K* is mounted on journal-pins *H*, having their bearings in the arms *F*. These journal-pins, which constitute the axle of the wheel *K*, are in one piece with metal plates fastened to the flat center portion of *K*. Wheel *K* is of non-conducting material, so the two journals of the shaft are insulated from each other. The contacts are made in the form of rollers of conducting material mounted loosely, one on each pin. These contacts also bear against the sides of the arms *F*, through which they are in electrical contact with the conductors. The edges of the side plates are inclined so as to form a continuation of the side of the roller-contacts. The disk is provided with a metal rim *N* to diminish wear.

The Ilgner Dynamo.

In the accompanying illustration is shown a new dynamo, designed and built by Carl Ilgner & Co., Minden, Germany. It is a four pole machine, and in external appearance is similar to the iron clad type. The armature is of the drum type, and for machines of over 3,000 watts' capacity has only one layer of wire. The core is laminated, and is built up of Swedish sheet iron of little over one-half millimeter



THE ILGNER DYNAMO.

in thickness. It is also screwed and bolted together firmly and mounted on the shaft in a way that prevents any slipping. The commutator is made of phosphor bronze, each segment being removable and interchangeable, and is fixed to the shaft with a double set of screw rings. The armature wires are fastened to the segments with a peculiar screw arrangement which serves to facilitate repairs on the commutator. The fields, which are built either shunt or compound, are so placed as to radiate, so to speak, from the armature. This dynamo is built in 25 different sizes. One of the principal claims for the machine is its exceedingly slow speed. The sizes, ranging from 3,000 to 55,000 watts capacity, have a speed of from 400 down to 150 revolutions per minute. Another group specially built for direct coupling to slow running engines or gas motors has, it is claimed, an output of 8,250 to 82,200 watts, and has the slow speed of from 150 to 80 revolutions per minute. The illustrations are reproduced from the *Elektrotechnischer Anzeiger*.

Controlling an Engine by Electricity.

The cuts illustrate the more important features of an electro-hydraulic system devised to accomplish the quick stoppage of a steam engine n case of accident. The system is intended to

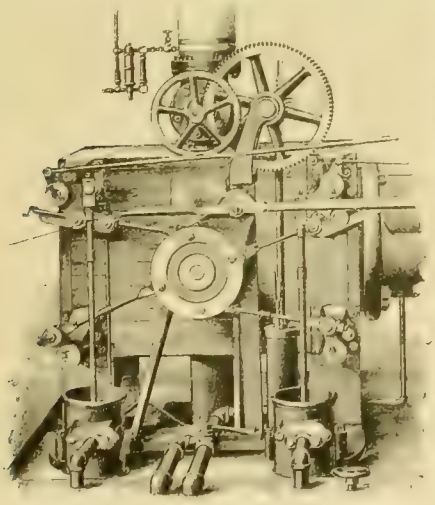


FIG. 1. CONTROLLING AN ENGINE BY ELECTRICITY.

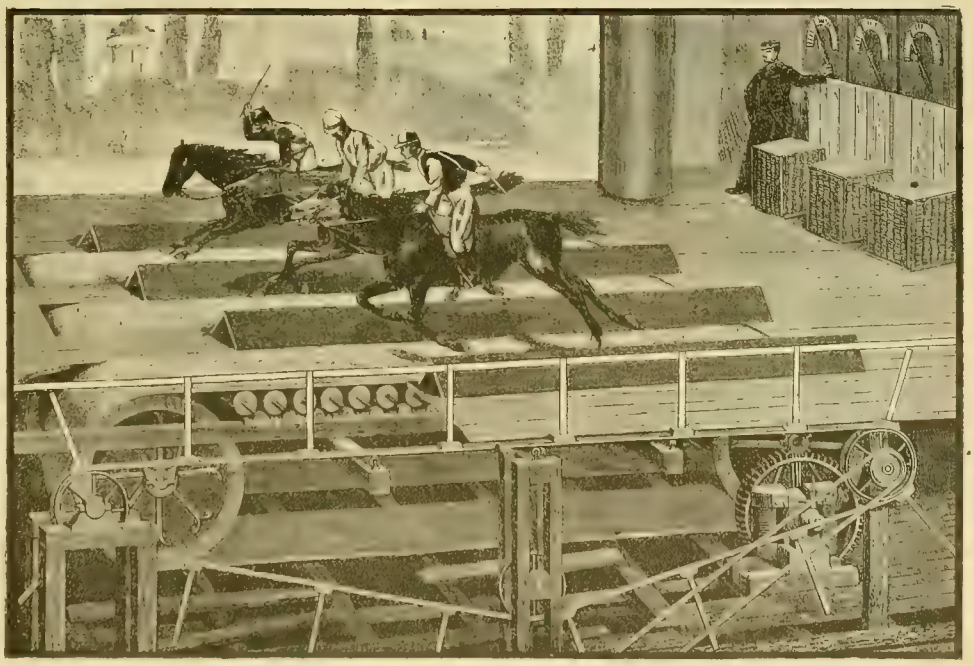
extend throughout an establishment in such a manner that an engine, with all attached machinery, may be quickly and silently stopped, independent of any action on the part of the engineer, and more smoothly than if the engineer were standing with his hand on the throttle at the instant the switch was moved.

As will be seen, a hydraulic valve is actuated by the electro magnet, Fig. 2, when a handle at any station in the building is turned. Water is thus admitted to a hydraulic cylinder which is located behind the right hand dash-pot of the engine, shown in Fig. 1. A rod attached to the piston of the hydraulic cylinder is formed with a rack at its upper end. This rack engages, as indicated, with gearing at the throttle. The raising of the piston closes the valve. Water pressure is obtained from any desired source, or steam pressure is employed. The moment the throttle commences to close a recording instrument indicates the number of the station in the building at which the switch was moved, and an alarm bell begins to ring and continues to ring until a switch at the recorder is moved.

It is perhaps needless to mention that this system, which is controlled by the Ongley Electric company of New York, could be applied for various purposes besides the throttling of a steam engine. The cuts were taken from the *Iron Age*.

A Horse Race on the Stage.

One of the features of Montreal and Blondeau's "Paris Port de Mer," played at the Varieties Theater in Paris is a horse race. Three genuine horses, says *L'Illustration*, ridden by three genuine jockeys, start off at full speed, and make the circuit of the hippodrome of Longchamps. The horses are free from all restraint, and really gallop, but the ground passes under their feet in moving in a direction opposite that of their running, and the landscape as well as the fences also fly in a direction contrary to the forward motion of the horses. The cut shows the simple arrangement by means of which this theatrical illusion is operated. The three horses run upon three tracks independent of each other, but arranged side by side. The illustration represents, in section, one of these tracks, formed of an endless matting of cocoanut fiber similar to the mats that serve for wiping the feet, but of thicker and closer texture. This belt, which is three feet in width, runs over two drums placed on



A HORSE RACE ON THE STAGE.

bach side of the stage, and is held taut by a third roller on a level with the stage floor. The upper half length of the belt runs as shown over a series of wooden rollers. The belt is driven by an electric motor taking current from a battery of accumulators located on Feydeau street, in the vicinity of the theater. The apparatus operates as follows: At the time of starting each horse appears upon one of the tracks, the current is switched on, and the belt begins to move. The horses, feeling the floor sliding and carrying them backward, first begin to move their feet in order to maintain their position, and then, when the motion of the track becomes swifter, the jockeys begin to excite them with voice and spur, and they begin to gallop faster and faster in proportion as the motion of the belt under their feet is the more rapid. Despite the speed, the courses always occupy the center of the tableau circumscribed by the frame of the stage, the background of which is formed of a panorama of Longchamps.

An equilibrium is maintained between the two

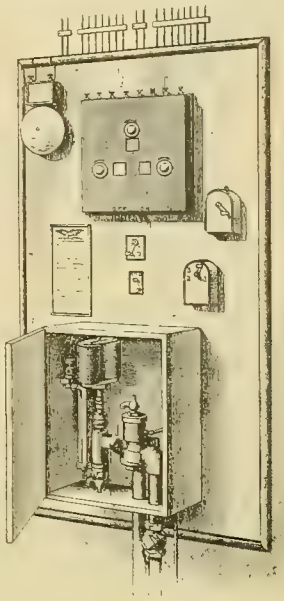


FIG. 2. CONTROLLING AN ENGINE BY ELECTRICITY.

impulsions by a very careful regulation of the motors. The illusion is completed by the unwinding of a canvas in the rear, 95 yards in length, representing the panorama of the country as seen from the stands of Longchamps. This canvas, which is first wound around a vertical cylinder on the right hand side of the theater, unwinds therefrom and afterward winds around a duplicate cylinder on the left hand side of the theater. The two cylinders are set in motion by a windlass manœuvered by manual power. The fence whose pickets are seen flying in the foreground, in the same direction as the panorama, is mounted upon an endless belt running around two drums actuated by a Popp air motor. The panorama unwinds in a minute and a quarter. During this time, the endless belt moves at a velocity of 3,200 feet per minute or, in other words, at the rate of twelve or fifteen leagues per hour. The designers of this mechanism are L. Brader, who constructed the tracks, M. Solignac, who installed the electric motors, and M. Justin.

The apparatus used in this race is very similar to that used in the American play, "County Fair," and was adapted, it is said, from the American play.

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W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. B. O'HARA, - - - - - - - - - - - } Associate Editors.
F. L. PERRY, - - - - - - - - - - - }
W. E. KEILY, - - - - - - - - - - - }

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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IT is probable that the electrical interests will secure due recognition at the World's Columbian Exposition, as the agitation which the WESTERN ELECTRICIAN started a month ago has been forced upon the attention of the Board of Directors. A conference of directors and representatives of the electrical department and the construction department was held last Monday and the subject was discussed, but was not disposed of. A report of the meeting is presented elsewhere.

Chief Burnham and Engineer Gottlieb based their arguments on the fact that it was now too late to change the plans of the grounds and buildings, which they claim would be necessary if the demands of the electrical people were granted. It should be remembered, however, that the construction department is in reality responsible for the present condition of affairs. Mr. Burnham says he is following the directions of the Board of Directors, but he has had plenty of time to change the proposed plans. When the WESTERN ELECTRICIAN a month ago announced that the proposed building was too small for the electrical display Chief Burnham was called upon to change the plans. He admitted the justice of the demand, yet he refused to grant it and has done everything in his power to obstruct the action of the electrical people in securing a hearing.

Chief Barrett, Col. Clowry and Lieut. Badt who appeared in the interest of the electrical people before the conference, endeavored to impress the directors with the importance of the electrical interests. Facts and figures were presented showing the rapid growth of the electrical industries and their present position in the financial world. It was shown that the division of the electrical exhibits as proposed by Chief Burnham would prove a great injustice to the electrical people.

The directors were impressed with the force of the arguments presented by the representatives of the electrical fraternity, and expressed a willingness to do all in their power to give the department ample space. They do not seem, however, to know of any solution of the problem, but it is hoped the matter will be satisfactorily settled within a week.

The subject has been referred to a joint committee of the Board of Directors and National Commissioners, and the question will be thoroughly discussed by them.

In the meantime every effort should be made to convince the commissioners and the directors of the necessity of granting the demands of the electrical people. The agitation for a building suitable for the display should not be dropped until the matter has been definitely settled. If the directors and commissioners refuse to grant these demands then they must assume the responsibility for the failure of the exhibition, for in the eyes of the electrical people it will certainly be a failure if the exhibition is divided.

THE placing underground of so vast a system of feeders as that employed in Minneapolis to supply the street railways with current, calls to mind the fact that we are a step nearer the complete underground conductor equipment. Last week the readers of the WESTERN ELECTRICIAN were confronted with illustrations of an electric railway, which showed only too plainly that the American electrical engineer had to all appearances fallen behind in one line of work. If in Buda-Pesth, lines of 1½ and 2¼ miles long can be operated successfully with current supplied to the car motors from a conduit below the level of the rails, are we to suppose that American companies which have startled the world with a phenomenal production of ingenious and practical electric railway machinery, cannot develop an efficient conduit system? We think not. Perhaps history may repeat itself, and, as in the lighting business, the overhead system will continue to be the "only practical one" until the situation becomes such that we are brought to a realization that there exists "a will," and consequently, we will have to find "a way."

It is a curious fact, that within a very short time after the adoption of the armature-on-the axle equipment on the City and South London railway, American electrical companies began to advertise that they were in a position to furnish car motors without gearing. It is not to be doubted that a practical conduit system will be ready when the proper time comes, but it is to be regretted that the German engineers are now in a position to claim a distinction which should more properly belong to Americans.

THE fact that Mayor Grant of New York gave another exhibition of his temper at the last meeting of the Board of Electrical Control was no surprise to the metropolis, though it must have been humiliating to the people of that city. Mayor Grant has made himself ridiculous in the eyes of the whole world. He will continue to gratify his spite, however, until the expiration of his term of office.

THE WESTERN ELECTRICIAN has received many compliments on its handsome supplement of last week showing the proposed electrical building for the World's Fair. While this journal has actively opposed the approval by the directors of the building as at present laid out, it realized the fact that the electrical interests were entitled to full and exact information as to the designs of the construction department the moment they were made public. This could only be done by an expenditure of considerable time and energy, and now that the result has been accomplished we are naturally gratified by the generous praise of our friends. Unless dwarfed by insufficient accommodation, the electrical display at the World's Columbian Exposition will be the grandest the world has ever seen. Located at the scene of the exhibition, the WESTERN ELECTRICIAN proposes to do its part both to further the interests of the Department of Electricity and to chronicle the features of the display as fast as they may with propriety be made public. We think that, with becoming modesty, we may refer to what we have already accomplished in this line as an earnest that this will be done.

THE description presented in this issue of the manner in which the electrical conductors of the Minneapolis street railway system were laid underground can not fail to interest the readers of the WESTERN ELECTRICIAN. It will be noticed that the feeders are of bare copper cable and are drawn into paper tubes, laid in a composition conduit. The casing for the conduit proper is located between the tracks of the system at a depth of only a few inches. Connections from the feeders in the conduits to the trolley wire are made by wires passing up through the iron poles of the line. As Minneapolis is one of the pioneers in the matter of burying the most unattractive portion of the modern electric street railway equipment, the practical operation of the system, as regards reliability under varying conditions, will be closely watched by the street railway men of the country.

IN the last number of the *Electrical World* a considerable portion of the Chicago letter was devoted to the World's Columbian Exposition. Among other things was this statement: "The daily papers contain an illustration of the electricity building, but no official knowledge regarding it is to be obtained." Then follows the meager "published description" that had previously appeared in the newspapers, which is incorrect as well as insufficient. We condole with our contemporary in its lack of "official" knowledge and suggest that, if it desires to obtain the latest news about the World's Fair, it change its weekly publication day so as to take advantage of the news presented by the WESTERN ELECTRICIAN.

We are desirous of aiding the exposition in every way possible, and our contemporaries are welcome to the news and illustrations that we present. It would have been better for the *World*, for instance, had it awaited the appearance of this paper last week instead of publicly parading its lack of "official knowledge." Had it done so, it would have had the advantage of the fine drawings given in our supplement and of the accompanying two-column description, both of which were strictly "official." In addition it could have obtained much other news of an interesting character in relation to the needs and demands of the Department of Electricity which, by the way, has been given little attention by many of the other electrical papers. Of course all this would be a trifle old by the time the *World* got it, but our New York contemporary might better take a rear place in the procession, rather than confess in advance its inability to take any place, as it did last week.

Electrical Measuring Instruments for Schools.

In the accompanying cuts are illustrated a number of electrical testing and measuring instruments for the use of schools and students beginning laboratory work. Electrical science has made such rapid advances that untrained skill is no longer of much avail, nor have the colleges themselves been able to properly do all

FIG. 1. ELECTRICAL MEASURING INSTRUMENTS FOR SCHOOLS.

that is required of them in keeping up and at the head of investigation, while, at the same time, attempting to give elementary instruction. As a consequence each year more of this elementary work is relegated to the high schools and preparatory institutions. Most of these schools, however, supported by municipalities or by private endowment, are unable to purchase high grade testing instruments, even were it desirable to put such extremely delicate instruments in the hands of beginners. It is claimed for the instruments shown that while capable of doing accurate work they are especially adapted to the use of beginners, as they are strongly made and have their delicate parts so arranged as to be easily and quickly replaced in case of injury.

Fig. 1 shows a reflecting galvanometer of the Thomson type; a small brass cylinder with glass face may be pushed backward and forward in the central axis of the coils, thus altering the size of the air chamber in which the mirror swings, and enabling the deflections to be made dead beat. In the Edelmann type, shown in Fig. 2, the mirror is attached to a bell magnet moving in a mass of copper; by removing this mass of copper the instrument is made ballistic, thus making it useful for measurements of condenser capacities, battery resistances, comparison of electromotive forces, etc. The coils are readily removable, as seen by the illustration, and may be changed in a moment for others of a higher or lower resistance.

Fig. 3 is one of four or five resistance boxes

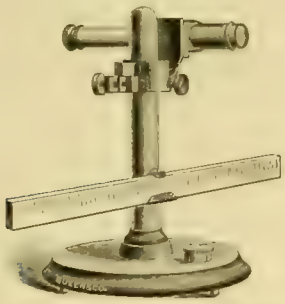


FIG. 4. ELECTRICAL MEASURING INSTRUMENTS FOR SCHOOLS.

of this series. The instrument shown in the cut is a combination Wheatstone bridge and resistance set, having 12 coils in the resistance portion aggregating 1,110 ohms, and bridge arms of 10, 100 and 1,000 ohms on a side, thus giving a range of measurement from 1-100 ohm to 111,000 ohms.

There is also a reading telescope, Fig. 4. The base is of cherry and supports a central rod of the same wood. On the central rod are two rings which can be raised, lowered or rotated on the rod, while they may be securely fastened in any position by means of a set-screw in the lower ring. The upper ring carries the telescope and has a little lug held against a second set-screw in the lower one. By turning this set-screw a "fine" adjustment of the telescope in azimuth is secured. A set-screw in the upper ring allows the telescope to be adjusted in altitude. The instruments are placed on the market by Queen & Co., Philadelphia.

Standard Twin Conductor.

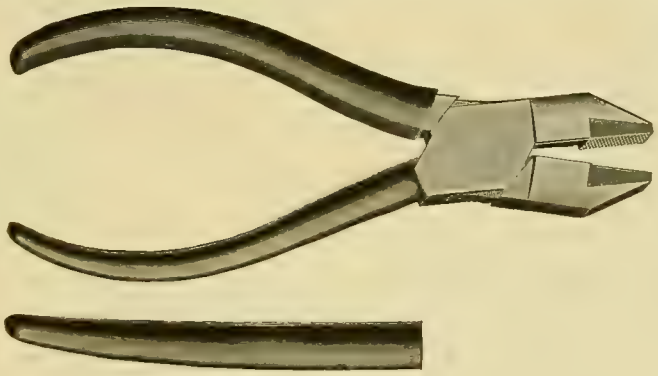
The Interior Conduit & Insulation company is introducing the standard twin conductor, illustrated herewith. It is claimed for the new conductor that it costs less than two separately insulated wires of like quality and capacity, and that it can be placed in smaller compass than any other double conductor or any two separately insulated wires, and therefore permits of the very desirable practice of placing the containing tubes on the ceiling and side wall surfaces and then covering them with the ordinary plaster, thereby obviating the bad practice of running the tubes under the floors or behind the lath and plaster, or of cutting channels in fire proofing.

Wisconsin Electric Club, Milwaukee.

At a meeting of the Wisconsin Electric club at Milwaukee last week Prof. J. E. Davies of the State university at Madison read a paper upon "Modern Extension of Ohm's Law." He traced the development of the terms involved in the

STANDARD TWIN CONDUCTOR.

ordinary expressions of the law, and argued the insufficiency of the original statement of the law. It was claimed that very many phenomena have been observed since the introduction of



RUBBER PLIER HANDLES.

alternating currents that cannot be explained according to the law as originally stated. It was necessary to re-state the law in a much wider form, he said, in order to meet the modern requirements, such as the consideration of inductance, static capacity and permeability of the medium. It was asserted that only by consideration of the qualities of the surrounding medium could the problems that arise in modern practice hope to be explained. At the conclusion of his address Prof. Davies was complimented by the members of the club for his able arguments.

Fight Against a Telephone Company.

There seems to be a misunderstanding between the Board of Commissioners of Asbury Park and the New Jersey Telephone company, which holds a franchise in that town. So serious has this trouble become that the commissioners have ordered the company to remove all its poles from the streets in the town. No reason was given, but it is alleged that the commissioners believe that the telephone company is charging excessive tolls for the use of instruments, and also that it has refused to grant the town the free use of ten telephones. When the company first began business the rates were moderate, but they have gradually been raised until, at the present time, they are $50 a year to old subscribers and $60 to new ones. The town receives money from the company for its franchise and has the free use of only two instruments, both in the fire engine houses. At Long Branch the same company gives the town the free use of ten telephones, and Asbury Park wants equal privileges. The time set for the removal of the poles is sixty days, and unless

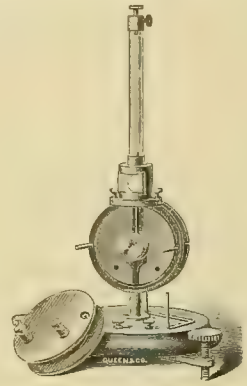


FIG. 2. ELECTRICAL MEASURING INSTRUMENTS FOR SCHOOLS.

satisfactory arrangements are made before that time the town will be without telephone service.

Rubber Plier Handles.

Workmen handling live conductors know that the handles on pliers ought to be insulated, and frequently resort to some crude method of supplying this protective covering, such as slipping a piece of soft rubber tubing over each handle or wrapping tape around the same. The cut represents rubber plier handles moulded from good rubber stock, fitting the handles snugly, and giving the hand an extra grip on the pliers. They are made to fit the several sizes of pliers used by electrical workers, and are already in use in many stations. George Cutter, Chicago, has the general western agency for them.

American Institute of Electrical Engineers.

The secretary of the American Institute of Electrical Engineers has issued a circular announcing the annual and general meeting of the Institute in New York, May 19, 20 and 21.

The Phonograph in Medicine.

The last meeting of the New York County Medical society was given up chiefly to a discussion of the phonograph, which was much enjoyed by the members.

Dr. J. Mount Bleyer read a paper on the value of the phonograph in medical science. Physicians would find it very useful in recording the various sounds of the human voice, especially in the treatment of throat diseases, such as croup and diphtheria, when to have a record of the patient's voice in its normal condition would be very desirable. Phonographs could also be brought into use as readers of books, or sketches to patients in hospitals. Dr. Bleyer said that he had been informed by Mr. Edison that the entire novel of "Nicholas Nickleby" could be produced on four cylinders of a phonograph.

Going outside of medical science, the lecturer said that in due course of time the phonograph would undoubtedly be brought into use as an instructor of foreign languages and as an automatic teacher of elocution.

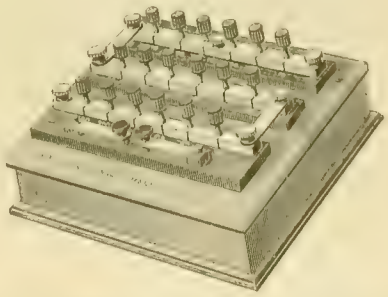


FIG. 3. ELECTRICAL MEASURING INSTRUMENTS FOR SCHOOLS.

Several phonographs were brought into requisition for the entertainment of the assemblage. One played the cornet, another reproduced a waltz as played by a brass

band in Orange, N. J., and a third gave an exact reproduction of the crying of a baby four months old.

Lieut. G. Bettini, the patentee of the micro-graphophone, exhibited his instrument and explained its points of difference from the Edison phonograph. Its purpose was distinctly enunciated from its own gutta percha throat, as follows: "My name is Micro-Graphophone, and my business is to record and reproduce the human voice in its different sounds." Lieut. Bettini talked, sang, coughed, whistled and breathed into the instrument, and each note and sound of his voice was sent back into the hall with perfect distinctness.

World's Fair Electrical Department.

The question of securing additional space for the electrical building of the World's Columbian Exposition was brought officially before the local directors last week. The communications, presented in another column, in which Chief Barrett formally petitioned Director-General Davis to take up the question of securing ample space for the electrical department, was referred to the committee on electricity of the Board of Directors. On Monday afternoon this committee had a conference with the committee on grounds and buildings. Chief Burnham and Engineer Gottlieb represented the Construction Department, and Chief Barrett and Secretary Hornsby looked after the interests of the Department of Electricity. President Baker of the Board of Directors was an interested member of the conference, and there were also present the following named directors: Col. R. C. Clowry, Messrs. Jeffrey, Schwab, Saul and Lawrence.

B. E. Sunny, of the Committee on Electricity, was in New York, but he was represented by Lieut. F. B. Badt.

Col. Clowry announced the object of the conference and read the letters of Chief Barrett to Director-General Davis and Engineer Gottlieb. An interesting discussion then followed. Chief Barrett explained the position of his department and the demand of the electrical people. Chief Burnham said that Chief Barrett had approved the plans prepared under the direction of the Construction Department and read a letter from the architects to this effect. In reply Chief Barrett said that three days after his appointment as Chief of the Department of Electricity he was shown pencil sketches of the proposed electrical building. He informed the architects at that time that the plans were so incomplete that he could tell nothing about them. Moreover, he desired to give the matter further consideration and consult the electrical interests before passing upon them. "If that can be considered an approval, then I approved them," said Chief Barrett. Lieutenant Badt presented an array of figures which proved a revelation to the directors. He called attention to the fact that the former electrical exhibitions had been far more extensive than the proposed electrical display at the World's Fair. The growth of the electrical interests was referred to and the necessity for a representative exhibit urged. The speaker said the only way this could be accomplished was by giving the electrical people plenty of room for an undivided exhibit. He explained that while the ordinary manufacturers could content themselves with a division of their products, if necessary, the electrical people must of necessity have all their devices and appliances grouped together or else the grand effect of their display would be lost. Continuing in this strain, Lieut. Badt said: "If you once begin to divide the electrical display and draw upon it you will soon find that there will be little left to the department of electricity. Electricity is applied to so many industries today that, if you were to place the devices and machines for each in the department assigned the industries to which they are applied, you would have nothing left for the electrical building. We insist that it is necessary to have a united display. There is as much sense in dividing the electrical exhibit as there would be in showing a suit of clothes in several buildings—a coat in one building, the vest in another and the trousers in a third."

Lieut. Badt assured the directors that the electrical people would not ask anything unreasonable. "We want," he said, "enough space to show our apparatus under one roof. We think we are the best judges of our needs, and we believe the building assigned us is too small. Now, we are giving you timely warning and we want to place the responsibility with you should the electrical exhibit prove a failure. We are ready to make it the crowning feature of the exposition, if given the space desired. If this is not done, we wish to serve notice upon you that the interest of many electrical people will cease and that the enthusiasm for the success of the fair and the electrical display will diminish. It is for you to say whether you will co-operate with this important industry or disregard it and allow its display to be of secondary importance."

At the conclusion of Lieut. Badt's remarks Chief Burnham asked the speaker if Edison would not like to have his mining machinery in the mines building. Mr. Badt said he did not know what Mr. Edison's personal views were on the subject, but that the electrical people generally did not want a divided exhibit. Then again, Edison insisted upon having his display at Paris in one place and the speaker thought he would like to have it united at the Columbian Exposition.

A general discussion followed, and the question was finally referred to the joint meeting of the committees from the National Commission and Board of Directors on grounds and buildings.

Relative Cost of Electric, Cable and Horse Railways.

There has been little official data concerning the cost of operating street railways, and the announcement that the census department has purposed a report on this important subject will be received with much interest. Superintendent Porter has just published a bulletin summarizing the regular census report regarding the relative economy of cable, electric and animal motive power for street railways. It was prepared by C. H. Cooley, under the supervision of Henry C. Adams, the statistician of the Inter-State Commerce commission. While it is stated that it is too early to form a final judgment regarding the value of electric motive power for this purpose, yet the statistics throw considerable light upon the matter. The bulletin covers statistics of fifty lines of street railway, ten of which are operted by cable, ten by electricity and thirty by animal power.

The total cost of the ten cable roads, including equipment, was $26,351,416; total number of passengers carried, 101,995,695, at a total cost of $3,286,461. The operating expenses per car mile were 14.12 cents, and the operating expenses per passenger 3.22 cents. The length of all tracks was 143 miles.

The total cost of the ten electric roads, including equipment, was $2,426,285; total track mileage, 67.22 miles; total number of passengers, 8,031,214, at a cost of $326,961, or 13.21 cents per car mile, and 3.82 cents per passenger.

The total cost of the thirty horse car lines, with equipment, was $22,788,277, with 552 miles of track; operating expenses for the year, $6,986,019, with 190,434,783 passengers; expense per car mile, 18.16 cents, and cost per passenger 3.67 cents. The expense per car mile on cable roads varies from 9.39 cents to 21.91 cents; on electric roads from 8.34 cents to 36.04 cents; on animal roads from 9.10 cents to 27.02 cents.

As far as the operating expense per car mile is an index of economy in operation, both cable and electric railways are cheaper than railways operated by animal power. It is noticeable, however, that electric railways, which have the least expense per car mile, have the greatest expense per passengers carried. The reason is that electric railways show a less number of passengers per car mile than either of the other classes. The cable railways were built at a cost per mile of street occupied of over seven times as much as the electric railways were. The density of passenger traffic is about six times as great upon the cable as upon the electric railways. These figures correspond to the generally accepted fact that cable railways attain their greatest efficiency where an extremely heavy traffic is to be handled. The railways operated by animal power hold an intermediate position.

Electricity in the Production of Aluminum.[1]

By Alexander S. Brown.

PART I.

The glamor that has surrounded this metal since 1856, when H. St. Claire Deville first obtained it in sufficient quantities to study its physical and chemical characteristics, and the almost monthly presentation before one or another of our scientific societies of papers treating of its properties, etc., makes it a most difficult subject to handle with originality. Scientific and newspaper eulogists have expended a great deal of time and many words in extolling the unusual combination of useful properties which it possesses and have given their imaginations full play in describing its future triumphs in the metallurgical world; but as yet little has been actually accomplished in the way of accurately determining the commercial status and mechanical value of this metal compared to others more familiar to us. While it must be confessed that in certain respects its merits seem such as to warrant great expectations, those interested in its production and its commercial success have experienced not only the usual difficulties inseparable from the introduction of any new metal, but many others due to the too great esteem the public has been led to bestow upon it. When sufficient knowledge of its characteristics has been acquired to form an unbiased judgment as to its true rank in the metallurgical world, there is little doubt it will be found to be one of the most useful metals ever discovered, and that it will not only largely displace copper, but will make for itself new and important fields of usefulness.

Still, of all the metals commercially familiar to us, aluminum has unquestionably made the most rapid progress. The long and tedious development of iron, steel, copper, tin, lead, zinc, etc., extending over centuries and centuries is familiar to us all. The fact that this new metal (only discovered in 1827, and extracted in perceptible quantities not earlier than 1854) has already entered into commercial competition with the oldest and most useful metals, substantially at their own prices, would alone make aluminum a most interesting subject of study and speculation.

In the year 1760, or thereabouts, a chemist named Morveau, by calcining alum, obtained a substance which he called alumina. Shortly thereafter Lavoisier suggested the existence of metallic bases in the earths and alkalies, and, naturally, alumina was immediately suspected of being a metallic oxide. Some interesting speculations were indulged in on this subject, and this hypothetical metal received the name of aluminum.

As early as 1807 Davy and others tried ineffectually to decompose alumina by various means, including the use of the electric current. A chemist named Oerstedt thought he had produced the metal in 1824, but a German chemist named Wohler was the first to actually demonstrate its existence. He extracted the metal in 1827 by decomposing the chloride of aluminum by means of metallic potassium; twenty years later he also reduced it with metallic sodium. The first commercial product was exhibited in 1854 by H. St. Claire Deville, a French chemist, whose researches as to its chemical and physical properties (fully reported in the French journals of the day) were so thoroughly exhaustive that his writings are still standard authority on the subject. He used several methods, the most successful of which was reduction by sodium. Patronized by Napoleon the Third, who entertained great expectations concerning the use of this metal in war equipment, Deville established commercial works near Paris, which, after varying fortunes, were finally permanently located at Salindres, France, and these works for many years produced substantially all the pure aluminum consumed in the world. It may interest you to know that up to 1886 the annual production of this metal was less than 10,000 lbs., of which 6,000 to 8,000 lbs. were produced in France. In 1860 it sold at over $90 per pound. In 1887 it was sold at $5 per pound and is now selling at $1 for a commercially pure article—this term signifying about 97 per cent. purity in the metal. It is known that by processes now in operation, the metal can be produced in large quantities at a price which will put it on a par with copper, bulk for bulk.

Until the dynamo came into commercial use, the production and development of aluminum was almost entirely along chemical lines. It is a metal that possesses remarkable affinity for oxygen and chlorine, and, so far as I know, only potassium and sodium are capable of extracting oxygen and chlorine from it on a commercial scale. Naturally, therefore, the history of its progress is interwoven with that of the commercial manufacture of sodium and potassium. As early as 1856, Alfred Monier of Camden, N. J., claimed to have successfully made sodium by a continuous process, as a preliminary step in the manufacture of aluminum, and later he exhibited several small specimens at the Franklin Institute. This is undoubtedly the earliest record of the production of aluminum in this country.

Three years later, in 1859, the first aluminum works in England were started at Battersea, near London, but no details concerning them are obtainable. In 1860 other works were successfully established at Newcastle-on-Tyne, by Bell Bros., which were operated with more or less success until 1874. These gentlemen seem to have been close investigators of the subject, and have published important information concerning the characteristics of this metal. Other spasmodic attempts to establish aluminum works were made in Germany and other countries, but it may be truthfully said that France, which created that industry, remained its home until the development of the electrical processes which have now superseded all others. The most important effort on this line was that of James Webster, who, in 1882, re-established the aluminum industry in England, forming the Aluminum Crown Metal company at Hollywood, near Birmingham. The principal features of his patent, which this company operated, were the large cheapening of the manufacture of alumina (Al_2O_3). He

[1]Read before the American Institute of Electrical Engineers, April 21, 1891.

claimed to obtain a product containing about eighty-four per cent. of alumina—a substantial gain upon other known processes—and also to save half the cost of manufacture by utilizing by-products. In fact this company was for several years a successful competitor in the English markets to the French works at Salindres, though its output was very limited.

About 1886, a young Philadelphian, H. Y. Castner, invented and secured a number of patents to cover an improved and economical method of making sodium, which he claimed reduced its cost to twenty-five cents per pound. This invention he took abroad, and in 1887 the Aluminum Crown Metal company was re-organized under the name of the Aluminum company, limited, and extensive works for the manufacture of sodium, primarily, and of aluminum, secondarily, were erected at Oldbury, near Birmingham. They were completed in July, 1888, and were alleged to have a very large capacity for producing aluminum. The reduction of aluminum at these works was conducted strictly on the lines of Deville's process—Castner's improvements being solely in the cheapening of sodium—and came to be known as the Deville-Castner process. Considerable quantities of metal were produced at these works, and most of it was of exceptional purity. As long as aluminum ruled above $3. a pound, they were commercially successful; but inasmuch as it takes nearly three pounds of sodium to make one of aluminum, and the various other steps in the reduction are rather expensive, this process has not been able to compete commercially with the less costly electrical processes, and the Oldbury works are now devoted exclusively to the manufacture of metallic sodium which finds profitable markets in Germany and elsewhere, being largely used in the chemical manufacture of antipyrine.

During the development of the various sodium processes to which I have above referred the possibility of utilizing electricity was not neglected. Among the earliest patentees in this field were Camille A. Faure in 1880-4, and R. Gratzel in 1883. Other inventors before those dates realized the value of electricity in smelting and other electro chemical processes, but they were the first to give practical direction to theoretical speculation. Nothing has recently been heard of Faure's process, but that patented by Gratzel in Germany, in 1883, was practically utilized by a firm at Hemelingen, near Bremen, called the Aluminum and Magnesium Fabrik. The Gratzel process consisted, substantially, in electrolyzing a bath of fused chloride or fluoride of aluminum by means of anodes composed of a mixture of carbon and alumina, the current being furnished by a dynamo, but for some reason it was abandoned by the company in 1887 for another process, the nature of which has been kept a profound secret.

Between 1883 and 1886 a number of inventors secured patents for electrical processes, but I need only mention those which, in the struggle for the survival of the fittest, have come into commercial prominence.

On April 2, 1889, Charles M. Hall, of Oberlin, Ohio, secured patents for a process of reducing pure aluminum. In this process alumina is dissolved in a fluid bath composed of aluminum fluoride and potassium fluoride, with, perhaps, an addition of lithium fluoride, this bath then being electrolyzed by means of an electric current conveyed to a carbon-lined furnace through an anode of some non-carbonaceous matarial. In electrolyzing this bath, the containing vessel is made to serve the purpose of the negative electrode. In another patent Mr. Hall claims the use of a bath composed of alumina dissolved in compound fluorides of aluminum with alkaline earthy metals, and in still another patent, the use of a bath composed of alumina dissolved in the fluorides of aluminum, calcium and sodium; these materials being obtained by melting together aluminum fluoride, fluorspar and kyrolite. With this latter bath a carbon anode can be used without the bath being affected by its disintegration.

The Hall group of patents is now controlled by the Pittsburg Reduction Company, of Pittsburg, Pa., which has had its metal on the market since March, 1889. The plant has a daily capacity for producing about 300 pounds of metal, the selling price of which was $2. per pound until the early part of March last, when it was reduced to $1. per pound for commercially pure aluminum of a guaranteed purity of ninety-seven per cent. The reduction in price, considered in conjunction with the limited amount of pure metal produced would appear to confirm the generally received impression that while the pure metal is specially adapted to the manufacture of articles of art and ornament, it is not displacing tin, platinum, silver, etc., to anything like the extent its admirers have supposed it would. The fact is, aluminum as a pure metal is not destined largely to supplant other metals in the arts and manufactures; it is to its alloys that we must look to redeem the inflated reputation of the pure metal. The true value and use of aluminum seems to have been forecast by Deville, who predicted for it an intermediate position between the precious and baser metals, in which relation to manufacturers he said it was destined to fill a long-felt and important want. He doubtless referred to the pure metal, but, curiously enough, his prediction applies with greater force to its alloys, which have been demonstrated by actual use and thorough tests to possess physical and chemical properties that place them above all other alloys of copper, iron, and in some instances even of steel.

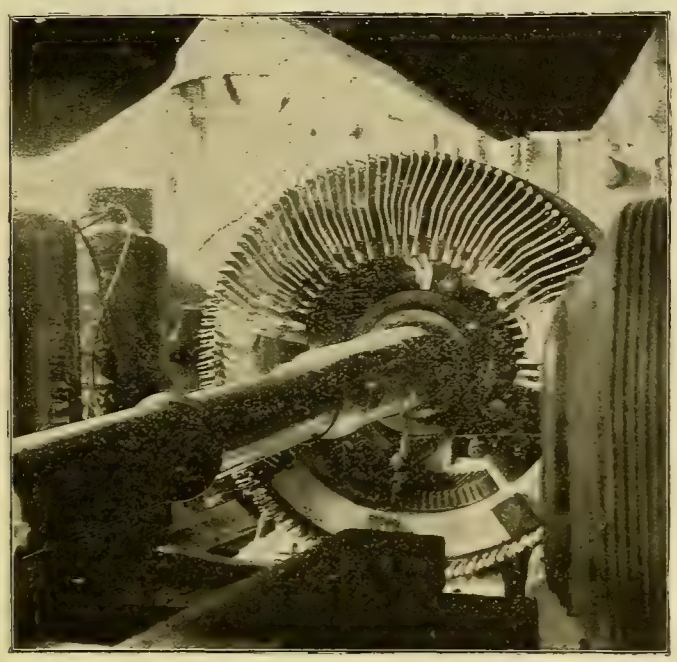


FIG. 2. ARMATURE OF OERLIKON DYNAMO.

The electric smelting process of the Messrs. Cowles of Cleveland, Ohio, was the first to secure a commercial footing in this country. These gentlemen have taken out a series of patents covering their process and they have exhibited very commendable energy and perseverance in establishing a market for their products. Both the process itself and apparatus used have been so frequently and minutely described that they are doubtless familiar to all of you, and a recapitulation of its details in this paper would be superfluous. As defined in numerous papers and publications emanating from, or inspired by, the inventors, the process may be described as the reduction of metals by smelting their ores with heat produced by the passage of an electric current through broken resistance material—that is, in the presence of an incandescent material (carbon being generally preferred). Stress is laid on the alleged fact that the reduction is purely and solely a smelting operation, due to a heat far greater than can be obtained by any agency other than the electric current. The electrical (chemical) effect of the current is distinctly disclaimed in their patents and publications. Perhaps I may not unprofitably consume a moiety of your time by explaining that the furnaces used at the company's extensive works at Lockport are rectangular and oblong in shape, comparatively shallow, and are composed exteriorly of walls of fire-brick or metal, lined with pulverized charcoal or other form of carbon or similar material, of electrical conductivity inferior to the ore to be smelted; this material being generally previously saturated with lime water to increase its resistance to heat. At each end of these furnaces are inserted rods of carbon which, passing through the walls and linings, are brought very nearly into contact within the body of the furnace, and, being connected to suitable wires or cables coupled to the dynamo, constitute the positive and negative electrodes. The charge consists, ordinarily, of a mixture (in different proportions) of an electrically resisting material—such as electric light carbon—and the ore to be reduced, though (in cases where the ore itself has sufficient electric resistance) the carbon is sometimes dispensed with. The charge fills the furnace and presses against the sides and ends of the electrodes, which project into the furnace. When a current of electricity is passed, the electrodes are so adjusted as to form an arc, and the current then flows from the sides and ends of the electrodes through the broken resistance material, which, of course, becomes incandescent, and the intense heat developed by this incandescence reduces the ore; the metal flowing to the bottom of the crucible and being subsequently tapped or dipped out when the charge is consumed. The gases liberated in the operation pass out through openings in the fire-brick cover of the furnace. From the character of the apparatus and manufacture or operation described, it will be obvious to you that the reduction of the metal is (as claimed by the Cowles company) accomplished by means of heat generated by the passage of an electric current through a mass of high resistance material, and that if the chemical effect of the current assists the reduction at all, such utilization is entirely accidental and unsought Neither aluminum nor any other metal is produced on a commercial scale by this process *as pure metal*.

The principal rival to the Cowles process for producing aluminum alloys is the Heroult process, which reduces aluminum and other metals from their refractory ores in the presence of another alloying metal and is contradistinguished from the Cowles process mainly by the fact that it operates exclusively—or at least almost entirely—by utilizing the chemical or electrolyzing action of the current. This process is the invention of a young French electrical engineer named Paul L. T. Heroult, whose affiliations with the firm of Messrs. Henry Merle & Co., owning and operating the Deville Aluminum works at Salindres, and his subsequent studies at the Polytechnic Schools at Paris and Switzerland, first directed his attention to the electrical reduction of aluminum. In 1886-7 he secured French, English and other European patents, covering several processes for the extraction of aluminum, silicon, boron, etc., from their ores, both as pure metals and in the form of alloys. On August 14, 1888, he secured a United States patent, No. 387,876, for the pro-

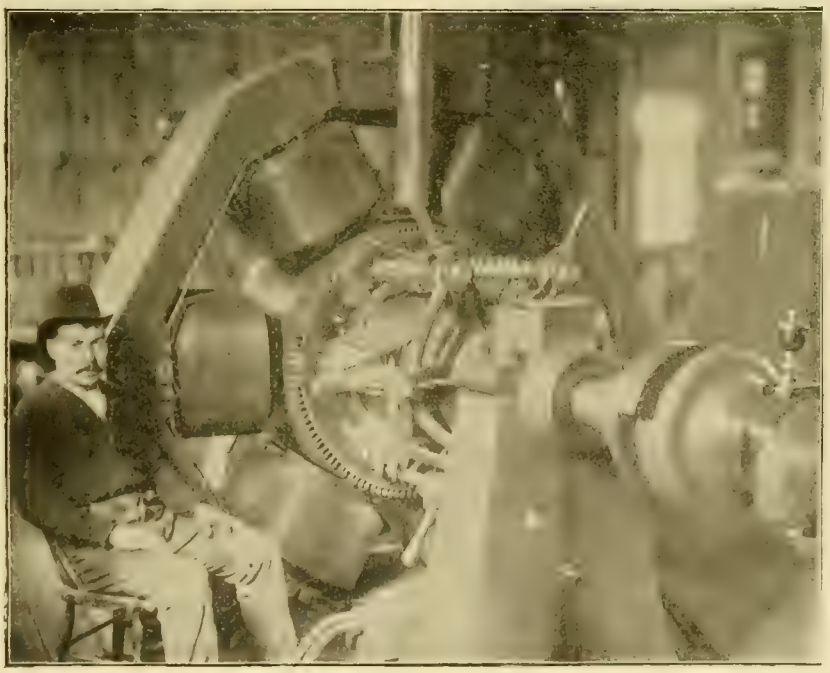


FIG. 1. OERLIKON DYNAMO AT BOONTON, N. J.

cess of preparing aluminum bronzes and their alloys, and it is understood has pending in the patent Office a series of applications covering other parts and features of his inventions. Though the Heroult processes have been very little discussed or even described in print, and are therefore almost wholly unknown to the public, their commercial success abroad has been far greater than has attended any other aluminum process, and while those owning the American patents seem as yet to have done little in the way of exploiting them, the success of a small plant put into operation at Boonton, N. J., for private demonstration purposes, in April, 1890, has been such as to give it rank among the prominent aluminum processes in this country. Having exceptional facilities for studying the workings of this plant during the past four months, I might be pardoned—especially as so little is publicly known of it—for describing it at length, but as I particularly desire in this paper to direct your attention to the electrical apparatus used at Boonton, by way of illustrating the great power and value of the electric current in metallurgical operations, it will suffice here to say that the patents of this young engineer, having first been acquired by Swiss capitalists, were afterward bought by the celebrated syndicate which, under the name of the Allegemeinen Electricitats Gesellschaft of Berlin, substantially controls the entire electrical field in Germany. This syndicate, after carefully examining all other processes then known, invested ten millions of francs in the Heroult process and is operating very extensive works, which obtain their power from the falls of the Rhine, at Schaffhausen. There they produce not only pure aluminum and all its alloys, but also alloys of silicon and other metals. Those works are supplied partly with dynamos of the type I wish especially to describe to you, and partly with dynamos of 600 electrical horse power, a complete description of which I regret I am not able to place before you at this time, as it would interest you. These machines weighing over fifty tons each, revolve horizontally; they have 24 pole pieces with collectors over 12 feet in diameter, and were especially designed for economical work.

To give you a comprehensive idea of the method employed by Mr. Heroult in manufacturing aluminum and its alloys—and so far as electrical apparatus is concerned, there is little difference between his and the Cowles process—it will be best to describe the electrical plant and crucible separately.

In the electrical apparatus the most important feature, of course, is the dynamo which generates the current. This machine was designed by C. E. L. Brown of the Oerlikon Works, Zurich, specially for electro-metallurgical work, and is the only one of its kind in America. It weighs, complete, over 19 tons, and when driven at 220 revolutions generates a current of 35 volts and 3,500 amperes. The general appearance and design of the machine is very well shown in the accompanying illustration Fig. 1. It is, as you will observe, a six pole machine, having an armature of the Gramme ring type, and the current is taken off commutators at either end by 72 brushes. The armature is 39 inches in diameter, and the shaft (including its clutch), is 11 feet 7 inches long. The commutators are each 19 inches in diameter and 20 inches long, each commutator containing 60 segments weighing 13 pounds apiece, or a total of 780 pounds for the segments for one commutator alone. The core of the armature consists of a very large number of sheet iron discs clamped together in a frame of aluminum bronze. About 3-8 of an inch from the outside edge of the core 120 holes pass from one end to the other, through each of which passes a copper wire ½ inch in diameter. These wires, which of course are thoroughly insulated from the core, form part of the winding. The remainder of the winding is composed of copper bars 1-4 of an inch thick, 31 inches long and 2 1-4 inches wide. The shape of these bars and the interior appearance of the armature can readily be seen in the illustration, Fig. 2. This photograph was taken about six months ago while the armature was being repaired in consequence of an accident. Though as previously mentioned, the works at the Rhine Falls are in part equipped with much larger dynamos of 600 electrical horse power, it has been found that they do not give nearly as economic results as the other dynamos of the kind I have attempted to describe. This latter type is also in universal use at Mr. Heroult's own works at Froges, France. At the time a friend visited the Schaffhausen works last summer one of these 150 horse power machines had been running without a moment's intermission five months, and another nearly four months. Though rated at 150 horse power by the Swiss makers, the same machine in this country would be rated at over 200-horse power, and would be driven at much greater velocity. In actual work they are frequently run up to 300 revolutions, and though it sometimes happens in practical operations that heavy short circuits occur, there is hardly any perceptible sparking at the brushes, even when the current rises to 8,000 or more amperes. The indicator attached to two of these machines (coupled in series) at the Rhine Falls has frequently recorded 25,000 amperes without any evidence of short-circuiting appearing at the brushes.

(*To be Continued.*)

The Incandescent Lamp.

An interesting discussion followed the reading of the paper on The Incandescent lamp, by Thomas G. Grier, before the Chicago Electric club April 20th. The paper was presented in the WESTERN ELECTRICIAN April 25th. Following is a stenographic report of the discussion:

PRESIDENT SUNNY. I think there is a great deal of truth in the statements that Mr. Grier has made that it is the cost of lamp renewals that worries the station manager, and not the loss of energy in other directions.

F. B. BADT: I cannot see but that the principles stated by Mr. Grier are perfectly correct. Of course it is clear that the more expensive one watt delivered at the lamp, the more efficient that lamp should be in order to use less energy, hence less fuel and less power. We can find a formula (similar to Sir William Thomson's) which will give us the proper ratio between the efficiency of the lamp and its life on one side, and the cost of the current or cost of watt delivered at the lamp on the other side of the equation. The cost of electrical energy, however, will depend on a good many circumstances. When I speak of the cost of the current or cost of electrical energy delivered at the lamp it does not mean only fuel and the actual operating expenses; it means a great many things besides. It means, for instance, interest on the money invested, depreciation, and good management or bad management, as the case may be. Take, for instance, a central station in the city of Chicago, where there has been a great outlay for copper conductors and conduits, the cost of electrical energy delivered at the lamps will naturally be higher than in a small central station where fuel is cheap and where they have overhead conductors whose erection costs very little money. Therefore, if a lamp of a certain efficiency will give economical results in Chicago it may not in a small central station which is run under different conditions. As a general rule I think it is true that in large cities having an underground system, where the whole running expenses are great and where the interest on the money invested is enormous, that it will pay to use a high efficiency lamp, while, on the other hand, in smaller stations, where the conditions are reversed, it will pay better to employ a lamp which is less efficient but lives longer. Therefore, the examples shown by Mr. Grier, while perfectly correct under certain conditions, must not be considered final, and one must not think that lamps of long life may not be most economical under certain conditions. What we should learn from this paper is to find out the conditions of each individual plant and then calculate to a dot what the efficiency of the lamp should be, to give the most economical results. I believe that this question has not been given the attention that it deserves, although I believe that if you examine the lamps used in central stations now, you will find that in large cities, in stations similar to our Edison station here, high efficiency lamps will be used, while, on the other hand, a station using, for instance, the alternating transformer system or other small central stations out in the country, where construction is cheap and operating expenses comparatively low, the long lived lamp will be mainly used. Although capitalists may not be electricians and may not figure out this thing according to formulæ, they can calculate it pretty closely, and they have a certain instinct which guides them to the proper solution of the problem. I believe that if all the plants are examined to-day on the basis of this formula we will find that we are not so far off after all, although in certain cases we may find something different.

CHAS. WIRT: The National Electric Light association at its last meeting was careless enough to adopt a report recommending an efficiency of incandescent lamps of somewhere about three and one half watts to the candle. It impressed me as being about as sensible as though the Engineers' association had adopted a report recommending a fixed boiler pressure under all circumstances. I believe we have as wide a variation in incandescent lighting as you will find in steam work, for there is about as wide a range of efficiency in lamps as in boiler pressure. Mr. Grier mentioned John W. Howell's paper on incandescent lighting. I do not think that paper has received the attention that it is entitled to. I must disagree with Mr. Grier in his statement that the subject of lamp efficiency has been neglected. It has been written on ever since the early days of incandescent lighting. It has been given a great deal of attention by people best fitted to analyze the subject. It seems to me that Mr. Howell's paper is classic and ought to be the primer of the central station manager. It is perhaps too much to expect that isolated engineers will go to the trouble of informing themselves on that subject. Mr. Howell's paper, I have no doubt you remember, does not contain any higher mathematics; he uses simple arithmetic. There is no formulæ in it. It proves that you cannot begin with a basis of efficiency for incandescent lamps except an efficiency which gives 15 or 16 per cent. of the total cost of the light in the cost of the lamp. The method of the paper is undoubtedly correct. There are one or two factors which can be introduced. One factor is the cost of replacing the lamp. That is a thing which has got to be considered. Your lamp has got to be replaced, and you may as well fix a certain amount for that. The other factor which should have been included, and which Mr. Howell did not include, and which has generally been omitted from al this discussion, is the depreciation of candle power of the lamp. We always know the candle power of a lamp when we buy it—at least, the maker is willing to tell us what it is—but nothing is said about the average. Perhaps the best tests ever made of the incandescent lamp were those lately published by Prof. Nichols, which we have all read and studied. It is very nice to start with a lamp giving 16 candles at 3 watts, and then congratulate yourself that you are going to run your lamps at 16 candles. You run them a few days or weeks and you see they are getting a little dim and you don't think much about it; but if you put your instruments on you will find that you are running your lamps five or six watts per candle. I have not tried to analyze the subject, but I believe it will be correct according to Mr. Howell's method if the average candle power is taken instead of the initial. In that case we could figure out our light, and make the cost of our lamp 16 per cent., and we would be quite well satisfied that we were running as near the most economical commercial figure as we could get.

MR. DOW: I do not want to libel any electric light company, so what I am going to say will apply to gas companies only, and if it fits the electricians they can take it up. As the story goes in Chicago, when the dividends get light and business is poor the gas company puts on the pressure at the works and we get more gas pumped through our burners and we don't get the light, but we pay for it all the same. Mr. Grier has, I think, purposely left out of his problem the question of who pays for the lamps. If the consumer pays for the lamps, while the central station has to pay the cost of furnishing the current, there is a divided interest. If the central station pays for the renewals, then it is a matter for the central station man alone to settle. But it is the universal practice, almost, that the consumer shall pay for lamp renewals. If there is anything that will make the consumer kick most vigorously, it is having to renew his lamps. And it does not matter about the cost of the lamp; he kicks just as much over a 45 cent lamp as he used to over one costing 80 cents. But the charge that I make against the gas company comes in upon the electric company once in a while in this way: Is it really to the interest of the central station where the cousumer pays for the lamps and where he buys his current by the meter to put in either an efficient or long lived lamp? If the lamp is of comparatively low efficiency, 4 or 5 watts per candle power, and the meter reads per watt hour, it seems to me that the central station owner's interest, on the face of the returns, is to put in just about as low efficiency lamps as he can. I think some of them go on that basis and put in a lamp that will use just as much current as the consumer will pay for. It is good business, perhaps. That is some hing that I am not prepared to discuss now. But I think Mr. Grier's paper reaches us as a plea for better construction; as a plea for more equal distribution of pressure. Now, I do not know in all my experience a central station where the theoretical condition of constant potential is anything like observed. I have experimented with lamps to ascertain what variation of potential would have a serious effect upon the life of the lamp, and I find that a variation of 3 per cent. above normal shortens the life; it increases the efficiency for the time being, but kills the lamp very quickly. I find in many stations, by careful tests under condition of full load, which ought to be the condition of most perfect balance, a variation of from 3 per cent. above to 3 per cent. below. If I do not find a total variation of more than 6 per cent. I think we are doing very well. In alternating current stations, especially stations which use a 50 volt lamp. I find even greater variations than that It is not surprising to find in secondary wiring under condition of full load a variation of three to four volts—I said volts, not per cent—it means six to eight per cent., and to see it compensated for, where there is complaint, at the most distant lamps by using a lamp of low voltage. In isolated plants a guaranty from the contractor of 2 per cent maximum variation under full load is very frequently given and just as frequently lived up to. In isolated plants that may be done, but in central station work the conditions are just the opposite. I think those of us who are putting up stations ought to study our distribution and do it systematically; study it at full load and at short load also, and see that we do really maintain conditions which are conducive to long life, and to the economical operation of our incandescent lamps.

MR. TERRY: I will say that we are bothered a great deal to know what lamp to furnish. One customer orders a lamp and complains of its short life, another one, because there is not efficiency enough, and we find that in most cases the trouble is with the voltmeter. A large number of the indicators in the stations are not accurate, and we have known of cases where there has been a change of from 5 to 10 per cent. in the voltage, which in the life of the lamp is very material. Mr. Grier gives us in his table B, footing up the thousand hours, the cost of the current to the lamp, $13 55. Now that simply shows the cost of the lamp compared with the current, the great importance of the right lamp, and the right lamp in efficiency compared with the cost. The footing there shows that for the first 500 hours it is $6.17, and for the last 500 hours $6.78; The consumers would save by throwing his lamp away at the end of 500 hours, but of course there is a difference in theory and the practice. The desires of the buyers, and the different conditions of power which have been mentioned here, change the results greatly. We have been asked a greatm any times about efficiency, but I have never heard any one ask about average efficiency nor have I ever seen any tables giving the average efficiency of incandescent lamps. It is generally the efficiency at the start. The lamp manufacturers can easily make a lamp of almost any efficiency they wish to. Of course a very efficient lamp falls in candle power at the start more rapidly, and it can be made so efficient that it is practically worthless after a hundred hours or less, while another lamp of less efficiency will maintain its candle power during its whole run.

PROF. BADT: We must bear in mind one thing, that tests made with a certain number of lamps turned out by a lamp factory probably for that test, not picked out indiscriminately, will not give us the average value of the lamp, to commence with I know it has happened with a company that I used to be connected with, that it would make a batch of lamps of maybe forty or fifty thousand, that would have certain properties, and the next batch they made would have very different properties as to efficiency and life. Unless you test a great many thousand lamps you cannot really get the average, because they will vary largely. You will see one lamp burning brightly for weeks, and apparently under the same conditions another will get dim in a few hours after it is put in. The test must embrace a large number of lamps and a great many makes of lamps. And next, what may be true of one make of lamps may not be true of another. It is hard to get at the average results and say what is the best under certain conditions. As valuable as these considerations may be they are absolutely useless for direct practical application, for the simple reason that we do not know the conditions. These tables are based on certain conditions which were assumed; they may or they may not exist. As long as we cannot determine the conditions exactly we should not advise people to calculate on this basis, as it may mislead them. I still think that under a good many conditions the use of a long-lived lamp is economical. There is nothing in the formulæ or in the tables that contradicts this statement. For instance, a water power producer may use the long-lived lamp, which will be the cheapest for him in the long run. I believe there are only a few stations in this country to-day where there has been a great outlay for the

central station plant for large copper conductors, and where the running expenses are high, where a high efficiency lamp will be the cheapest in the long run. As Mr. Grier say, his tables are derived from English experiments made with a few hundred lamps. I do not know of any experiments on which we could base tables which would be of practical value.

MR. WIRT: Mr. Grier says he is not quite sure whether Mr. Howell's fifteen per cent. is right or not. I am sure that his method is right if you put in those one or two factors. and if you follow it out you will come as near the right thing as circumstances will permit. I am familiar with the inside figures of quite a number of large successful central stations. I think that their proportion of total lamp cost is about fifteen per cent.; it may be twelve, or it may be eighteen; between ten and twenty.

There has been a little reference made to the meter charge that I cannot help referring to, that is the charge by watt hours. Central stations have watt meters, but I never heard of a station charging watt hours. I think the common practice is to charge by lamp hours. But in any case it is certainly to the profit of the station to use as economical a lamp as they can. Central stations are going to get all the money they can out of the district, and they have got to make their own calculation and decide upon their own lamp efficiency, and put in their machinery accordingly. It was my duty on a certain occasion to spend the better part of the year in trying to remove an error that existed in a commercial meter, and in speaking of the work to a very practical, hard-headed electrician he said, "If your meter is equitable it is all right; if it treats Smith the same as it does Jones. The electric light company is going to get all the money there is, no matter whether the meter reads high or low." I think that is a practical suggestion, and should be kept in mind very often in making our calculations.

L. A. FERGUSON: Prof. Badt, I believe, spoke of different districts in which lamps of high and low efficiency should be used, and he mentioned that in most large cities a three watt lamp should be used, whereas, in the country, where the alternating or perhaps the direct current system would be used, it would be better to use a lamp of low efficiency. He did not give the real reason for it. The reason is that in most country stations the construction work is very poor. I think in most large cities the plants in the first place are laid out very well, and if they are properly managed, and if the men in charge of the construction are careful to see that the work done by them is laid out properly, and that done by the outside contractors is according to the best methods, I believe that it will be found that a three watt lamp is much preferable to a four-watt lamp. The reason a four watt lamp has been successful in the past is because it will stand irregularity of pressure. In large cities I think the variation of pressure is not so great as in the country, where they have to run long distances, with varying loads on unequalized mains, and the four watt lamp will stand that variation much better than the three watt lamp. There is one thing in regard to the three watt lamp in preference to the four watt lamp. Suppose in a central station, such as we have in Chicago, where the maximum load is upward of 10,000 amperes, you were to change from a three to a four-watt lamp, what would be the result? It would mean an increase in your central station capacity one third. Whereas, in a central station such as we have in Chicago, where we are now running ten engines and twenty dynamos with a capacity of 2,000 horse power, we would have to put in immediately upon the change 600-horse power more—666 2 3 to be exact. That means increased dynamo men, increased engineers, increased firemen, and an increased investment.

Another reason, perhaps, why the four watt lamp has been successful, is that in most central stations in large cities until within two years, it has been the practice to run the lamps above their normal pressure. That practice has almost been universal in isolated plants. It is customary for the manager of a hotel or theater to telephone down to the engineer to run her up a little, and he shoves it up two or three volts, and in a short while he finds the lamps burning out. That is the reason why people cry for a low efficiency lamp with long life. I would say also that I think it has been found that it is much better to run a lamp a volt or two below normal pressure rather than above normal pressure. It gives better satisfaction to the customer, and your lamp does not depreciate, and you do not make your customer pay for increased current that he ought not to pay for.

MR. DOW: I take exception to the remark made that meters are in use indicating lamp hours. I know that it is the practice to make the bills read for so many lamp hours, but I say positively that there is not a meter in existence that indicates lamp hours. The best meters read in watt hours; and the others, which are merely current meters, are those which operate on circuits of presumed constant potential, and the potential being constant the current meters practically read in watt hours. If there is a meter in existence that will read lamp hours, will count the lamps burning, and will indicate such lamps, we are getting very near the ideal. What we want and may get some day is a meter that will indicate candle power hours, and then this discussion will be a thing of the dim and distant past.

The electric light has rapidly spread in Germany during the last three years. According to authentic reports, Elberfeld, Barmen, Stettin, Konigsberg, Hanover, Traben and Trarbach, on the Moselle, have been provided with electric lights. The two latter are small towns which have heretofore been even without gas. The central station for the two towns is situated at Traben, and connection is made by means of a cable which crosses the Moselle. The central station comprises two engines of 75-horse power driving four dynamos for feeding about 1,200 incandescent amps, and ten arc lamps.

Some Possible Modifications in the Methods of Protecting Buildings from Lightning.[1]

BY N. D. C. HODGES.

I remember with what hesitation I ventured some months ago to explain to your fellow-member, T. C. Martin, my ideas on some possible modifications in the method of protecting buildings from lightning. But as he was kind enough to express the belief that there was something in what I had to say, I have ventured to come here this evening to explain my ideas to what must be an extremely critical audience.

To begin with, I have always belonged with those who have been skeptical as to the utility of lightning rods as ordinarily placed on our houses. I was never able to understand, and cannot now, why, if a lightning rod as ordinarily introduced was useful, the lightning should scent out a bad earth connection at so considerable a distance. I mean that I could understand the ordinary theory of the rod if invariably the electrical discharge followed the rod as far as its conductivity was good, only to leave it when the bad earth connection was reached.

I am aware that the advocates of the old form of rod, point to the apparent beneficial effects of the Harris system as introduced on ships. This may be due to the possibility of making an especially good earth connection, or it may be due to their having been introduced on ships about the time that rods were introduced or some other modification which has had a beneficial effect. I have some suspicions on this point, and find it recorded in the London *Electrical Review* that lightning does not play as destructive a part as it did forty or fifty years ago, and that even those ships unprovided with conductors have suffered less damage than a smaller number of ships experienced formerly. Not that modern vessels are exempt. but they seem to be struck in a manner which causes fewer fatal accidents, and in some cases even the effects of a lightning flash have borne so little trace of their origin that they have been credited to the wilful act of some one on board

Ordinarily a lightning rod is regarded as a conduit or pipe for conveying electricity from a cloud to the ground. The idea is that a certain quantity of electricity has to get to the ground somehow; that if an easy channel is opened for it, the electricity will pass quietly and safely; but that if obstruction is introduced, violence and damage will result. This being the notion of what is required, a stout copper rod, a wide-branching and deep-reaching system of roots to disperse the charge as fast as the rod brings it down, and a supplement of sharp points at a good elevation to tempt the discharge into this attractive thoroughfare, are naturally guarantees of complete security.

I think Oliver J. Lodge has expressed well the difficulty that has always been present in my mind when I have read detailed descriptions of the effects of lightning. He says that when, in spite of all precautions, accidents still occurred; when it was found that from the best constructed conductors flashes were apt to spit off in a senseless manner to gun barrels and bell-ropes, and wire fences and water-butts,—it was the custom to more or less ridicule and condemn either the proprietor or its erector, or both, and to hint that if only something different had been done,—say, for instance, if glass insulators had not been used, or if the rod had not been stapled too tightly into the wall, or if the rope had not been made of stranded wires, or if copper had been used instead of iron, or if the finials had been more sharply pointed, or if the earth plate had been more deeply buried, or if the rainfall had not been so small, or if the testing of the conductor for resistance had been more recent, or if the wall to which the rod was fixed had been kept wet,—then the damage would not have happened. Every one of these excuses has been appealed to as an explanation of a failure; but because the easiest thing to abuse has always been the buried earth connection, that has come in for the most frequent blame, and has been held responsible for every accident not otherwise explicable.

I have to say, therefore, that up to about two years ago I was simply in the dark as to what was the matter with lightning rods. I could not accept the reasoning set forth in the report of the Lightning Rod conference or in any of our books. It did not seem to me that the arguments in support of the ordinary lightning rod were logical. It seemed to me that there was something that we did not understand.

About two years ago one of the oil tanks at Communipaw or Bayonne, just off the New Jersey Central railroad, was struck by lightning, and, as I pass that way each day, my attention was again called to the question how we should protect our buildings from lightning; and one evening, taking up Silvanus P. Thompson's little book on electricity, I think it was, to see what he had to say about lightning, I re-read the ordinary theory of the formation of the high potentials that are manifested in lightning discharges.

This theory is simply this: That if, in the cloud, there is a certain quantity of electricity distributed on a given mass of fine mist, it will exist there at a certain potential, depending on the capacity of this finely divided matter. Now, if these mist particles coalesce into raindrops, the theory points out that there would be a decrease in the electrical capacity, and a consequent increase in the potential of the charge. It occurred to me immediately, that, if this theory had any foundation in fact, it ought to be possible to reverse the operation on the surface of the earth; that is, to receive the lightning discharge on some large body, which would then be broken up into fine particles of vapor, which would have a considerably greater electrical capacity, and that the potential of the discharge would thereby be materially reduced, and the effects of the lightning mitigated. This was my hypothesis to work upon, and I immediately began to look through the records to see what actually happened in the case of lightning discharges, and to see if there was any support in fact for my hypothesis.

The first book at hand was Sir William Thomson's "Papers on Electricity and Magnetism," and I found that he described in detail the case of a farmhouse in Scotland, which was struck by lightning, and in which this very dissipating effect took place; that is, the bell-wires were dissipated,—an occurrence which, as you know, is extremely common when a lightning discharge takes place. I went on through the records, and found numberless cases of this, the oldest being that of the dissipation of the metal covering on the wooden shield of some Greek warrior. I mention this case as of interest, as it brings out a very fortunate circumstance, that when thin metal is dissipated against wood or even against plaster, no harm results to the wood or plaster. Of course you know it has been somewhat discussed whether this action is a dissipation through the heating of the metal, or whether it is a cold dissipation—a breaking up into particles, as it were—of the metal. On this point I have nothing to say.

But as I went on through the records I could not make the facts accord satisfactorily with my hypothesis. The dissipating action that I was looking for certainly took place, and is a very common accompaniment of lightning-discharges, but in spite of it, there was damage to the building. It was only after a considerable reading of the records that it gradually dawned on me that I had found no case where damage to the building occurred on the same level with the dissipated conductor.

I would thus formulate what seems to be true,—that a conductor that can be easily dissipated by a lightning-discharge, protects the building to which it is attached between two horizontal planes, the one passing through the upper end of the dissipated conductor, and the other at the lower end; and it is this one point that I would urge upon the consideration of the Institute.

I have taken the time of the Institute to tell how I reached this conclusion; but, as must always be, I reached it by making some false digressions. So far as I know, therefore, a conductor such as I have here—a conductor made light copper ribbon, so that seventy five feet of it will weigh only a pound, and made in sections two feet long, which shall be tacked to the building from its ridge-pole to the foundation, the joints being made of low conductivity by the insertion of insulating washers—will protect the building. The conductor will be destroyed by the discharge, Its destruction can take place, even against a plastered wall without injury to the wall; but no other harm will occur so far as the conductor extends in a vertical direction. There is no need of the conductor following the shortest course to the ground. There is no need of providing a good earth connection. I can see no difference between the two ends of the metallic ribbon. You do not attempt to make a good connection at the top with the dielectric, and I do not see why you should attempt to make a good connection at the bottom. In no case on record of the protecting influence of dissipatable conductors has this protecting influence depended upon there being a good earth connection. Of course the ribbon should not be boarded over. Free gunpowder burns harmlessly enough, but it causes damage when burned in a confined space; and the dissipation of a conductor presents similar phenomena.

It would not do to run such a conductor as I suggest here part way down the building, and then make it turn up again before its final descent to the ground, as in such a case there would probably be a line of disaster from the point where the upward turn began.

Doubtless, numerous improvements can be suggested, but letting this stand as the main point of what I have to say—that a dissipatable conductor protects,—it may be of interest to consider why it protects. But here you will understand perfectly well that while I can offer certain explanations which seem fairly plausible to me, it is not in the nature of things that I should have gotten at the whole truth.

In order to destroy a building in whole or part, it is necessary that work should be done; that is, energy is required. Just before the lightning-discharge takes place, the energy capable of doing the damage which we seek to prevent exists mainly in the column of air extending from the cloud to the earth in some form that makes it capable of appearing as what we call electricity. We will therefore call it electrical energy. What this electrical energy is, it is not necessary for us to consider; but that it exists, there can be no doubt, as it manifests itself in the destruction of buildings.

The problem that we have to deal with, therefore, is the conversion of this energy into some other form, and the accomplishment of this in such a way as shall result in the least injury to property and life. When lightning rods were first introduced, the science of energetics was entirely undeveloped; that is to say, in the middle of the last century, scientific men had not come to recognize the fact that the different forms of energy—heat, electricity, mechanical power, etc.—were convertible one into the other, and that each could produce just so much of each of the other forms, and no more. The doctrine of the conservation and correlation of energy was first clearly worked out in the early part of this century. There were, however, some facts known in regard to electricity a hundred and forty years ago, and among these were the attracting power of points for an electric spark, and the conducting power of metals. Lightning-rods were therefore introduced with the idea that the electricity existing in the lightning-discharge could be conveyed around the building which it was proposed to protect, and that the building would thus be saved.

The question as to the dissipation of the energy involved was entirely ignored, naturally; and from that time to this, in spite of the best endeavors of those interested, lightning-rods constructed in accordance with Franklin's principle have not furnished satisfactory protection. The reason for this is apparent when it is considered that this electrical energy existing in the atmosphere before the discharge, or,

[1] Read before the American Institute of Electrical Engineers, April 21, 1891.

more exactly, in the column of dielectric from the cloud to the earth, reaches its maximum value on the surface of the conductors that chance to be within the column of dielectric, so that the greatest display of energy will be on the surface of the very lightning rods that were meant to protect, and damage results, as so often proves to be the case. The very existence of such a mass of metal as an old lightning rod only tends to produce a disastrous dissipation of electrical energy upon its surface,—"to draw the lightning," as it is so commonly put.

Having cleared our minds, therefore, of any idea of conducting electricity, and keeping clearly in view the fact that in providing protection against lightning we must furnish some means by which the electrical energy may be harmlessly dissipated, it seems clear why it is that the use of sufficient energy to dissipate a pound of copper leaves not enough to do harm to other objects around. The question naturally arises how much energy there is available. There is stored up in each cubic centimeter of the column of dielectric from the cloud to the earth, just before the lightning discharge, an amount of electrical energy given by the expression $\frac{1}{8\pi} K E^2$, where K is the specific inductive capacity of the dielectric, and E the electromotive intensity, both in electrostatic units. This expression is given on p. 156, Vol. I, second edition, of Maxwell's "Treatise on Electricity and Magnetism." Substituting the values of K and E, and reducing, we find that the amount of energy involved amounts very nearly to one foot-pound for each cubic foot of air. This is, of course, a maximum value.

When this amount of energy is reached in any cubic foot the air breaks down, and the discharge takes place, and the amount of energy per cubic foot in the column of dielectric reaching from the cloud to the earth cannot be uniform, but must reach this maximum value along a central core, and diminish gradually from this value to nothing at a considerable distance. If we consider that the dissipation of this electrical energy takes place throughout the whole length of the column of dielectric from the cloud to the earth, we shall see that all the energy that we have to care for in our lightning rod is that existing in the section of the column contained between two surfaces passing through the top and foundation of our house respectively. I have said two surfaces, as doubtless they are not planes; presumably they are two equi-potential surfaces.

I am now coming to a point that I want to make clear, and that is that, according to the usually accepted theories of electrical action, this electrical energy is gradually stored up in the column of dielectric from the cloud to the earth, and that it is distributed in this column with the greatest amount per cubic foot along some central core, this amount not exceeding one foot-pound per cubic foot, and that this process can be continued until the stress is so great the air breaks down, when what we call a discharge of lightning takes place, and the electrical energy disappears, of course, only to take on some other form. You may say that the electricity travels from the cloud to the earth, or from the earth to the cloud, whichever you please; at any rate there is an electrical action in a vertical direction, the discharge being supposed vertical. I will ask, however, whether it is not true that the energy involved travels along the equi-potential lines; that is, travels in the main horizontally. It seems to me that it shrinks in, as it were, from the considerable column or ellipsoid of dielectric upon the central core, where it manifests itself as heat and light in the electrical flash. It will, then, be clear how it is that in providing a body upon which the dissipation of energy shall take place we have to guard against something not coming from above or below, but coming from the side, and that this may be the explanation of why it is that, so far as I have been able to find, a dissipatable conductor protects the building between two essentially plane surfaces passing through its upper and lower ends.

Have we not, then, in the lightning discharge, another illustration of the relation between light and electricity? If we suppose for a moment that in place of the central core where the electrical energy is dissipated we were to place some hot or luminous body, this body would constantly radiate energy into the surrounding space, and at any instant there would be in each cubic foot of this surrounding space a certain amount of radiant energy. Now, if this process could be brought to a stand-still at any moment, would not the conditions be in some degree similar to those just preceding the electrical discharge? There would be need of a certain force along the central core to maintain the various stresses throughout the surrounding medium; and if this central force were to be taken away as it is taken away when the dielectric breaks down and the spark passes, the stresses could no longer be maintained, and there would be a vibratory transmission of the energy back upon the central core.

But let all this be as it may, the main point which I would urge upon your consideration is that by giving the electrical energy something which experience shows it will readily dissipate, that is, a conductor of varying resistance and small size, we can but mitigate the effects of lightning discharges, so long as the conservation of energy holds true. I will only repeat that I have so far found no case on record where the dissipation of such a conductor has failed to protect the building under the conditions already explained.

The telephone seems to be advancing in favor in Egypt. At the last annual meeting a dividend of seven per cent. was ordered. It was reported that the business had been kept up to a fair point of prosperity. The benefits from the establishment of exchanges at Port Said and Assiout would, however, only be felt in this and following years, while the working expenses had necessarily increased on this account. For any large extension of business the directors said they must wait for the reviving prosperity of the country. Much of the trade had been transferred from Alexandria to Port Said and Suez

CORRESPONDENCE.

New York Notes.

NEW YORK, April 25.—The Board of Electrical Control has held several meetings during the week with the usual result. Mayor Grant got angry and said the board must not be trifled with. He proceeded to read the riot act to the electric light companies, saying: "For your benefit I will say that I have a list of poles which remain up in violation of orders, but I don't propose to give it out to the public until every one of them has been cut down." Expert Wheeler reported that one of the poles of the Mount Morris company in front of Ganzevoort Market carried both telegraph and electric light wires, which so nettled the mayor that he said to the companies: "I'm not going to allow you to trifle with this board. We'll find a way to make you obey its rules. You can't play your sharp tricks on us, and if we can punish you for this violation we will do it. We'll cut your poles down for you." President May of the Mount Morris company, in putting some pretty straight questions to Expert Wheeler, got him to admit that "he might have been wrongly informed." This turn made the mayor furious, and, turning upon Mr. Wheeler, he said, "I don't believe you know where the defective wires are yourself." It was finally decided to allow the electric companies ten days, exclusive of Sundays and half-holidays, in which to cut down the objectionable poles.

The Southworth electrical subway bill became a law by limitation this week. This gives the power to the Board of Electrical Control to divide the contract for building subways between the Consolidated Subway company and the Empire City Subway company. The latter company will build the subways for low tension wires, and it is believed that this contract will give the Bell Telephone company and the Western Union company a complete monopoly of the telephone and telegraph business in New York.

Commissioner Gilroy sent a communication to the board asking that it pass a resolution requiring that all subways and conduits constructed shall have pipes or other contrivances for the lateral house connections from the main subways or conduits to the curb at each of the manholes or boxes, at distances of fifty feet, in order that house connections at any of the points may hereafter be placed and connections with buildings be made without disturbing the street pavements after the main subways or conduits have been completed. The request was complied with.

Subways were ordered to be built in many of the streets in which overhead wires are now maintained, and also in all the streets which are condemned to re-pavement. They include the following named streets: Greenwich, from Fulton to Morris; Exchange place, from Broadway to William; Liberty, from West to William; Cortlandt and Dey, from West to Broadway; John street, from Broadway to Pearl; Fulton street, from William to Pearl; Vesey street, from West to Broadway; Park place, Warren and Chambers, from Greenwich to Broadway; White and Walker, from West to Broadway; College place, from Chambers to Park place; Canal street, from Greenwich to Washington; University place, from Ninth to Fourteenth street.

After a siege of darkness for about two years, the city is again assuming quite a brilliant look at night, and the electric light is gaining its former position. It has been a great fight, but the wires are nearly all underground and the city is paying the price of a more costly but more perfect system of electric lighting.

It is said that the Rapid Transit Commission has finally selected a route. Two routes have been under consideration, but the west side route with Broadway for a trunk line has the preference, according to report.

Superintendent Stoullar of the Brush Light company reports that the live wire which killed Richard A. Donaldson's handsome bays on Saturday night in front of 445 Broadway, was not a Brush wire. It was an iron housetop wire, he said, which had fallen across the Brush wires. The Brush linemen were at the time busy at the Grand street fire. As soon as they were able they went to Broadway, and cut the housetop wire. They were unable to determine the ownership of the wire. It might belong to any one of several burglar alarm or electric call companies. Mr. Stoullar said, "If the wire had been ours, or if our circuit had been out of order, there might have been a case, but our circuit was all right." W. H. T.

Pittsburg, Pa.

PITTSBURG, April 25.—The Wilkinsburg Electric Light company is about to increase the capacity of its plant. The company purchased some time ago all the lights and poles of the East End Electric Light company which the latter corporation owned outside the limits of the city of Pittsburg. When the Wilkinsburg company has finished the new power house it will have room for electric lighting machinery aggregating a capacity of 10,000 lights.

The Pleasant Valley Electric Street Railway company is now occupied with extending its main line from Allegheny City along California avenue, and since the work has been started the people along the route have gone to court against the company asking the judge to restrain the street car people from putting down "T" rails. The case came up yesterday, and Judge Ewing, before whom the matter was discussed, rendered a decision to the effect that the company could not continue the work of putting down rails unless the "T" rails were changed for some other kind.

The Citizens' Traction company of this city has nearly completed the extension of the cable line from Butler street to Sharpsburg. This extension is to be operated by electricity, the Westinghouse street car motors being used for the equipment of the cars. The road will be in operation by the first of May.

The Ohio Valley Electric Light & Power company, a corporation which was recently organized in this city, is now rapidly getting ready to commence operations in some of the suburbs of Pittsburg. The company is erecting a power house at Laurel Station, and when the entire system is completed the villages of Edgeworth, Bellevue, Avalon and several others along the Pittsburg, Fort Wayne and Chicago railroad will be supplied with electric current. E. H. H.

Indianapolis, Ind.

INDIANAPOLIS, Ind., April 25.—The Citizens' Street Railway company had fourteen trains in service on the Illinois street electric line last Sunday running to Fairview Park and even with these facilities could not accommodate all who wanted to go. It is improving the park. Among other attractions at this point there will be an electrical fountain.

Each of the storage battery cars on the Irvington line hauled a trailer last Sunday and gave entire satisfaction.

The Board of Public Works is still at work on the city light question, quietly gathering information.

The Broad Ripple company has secured a franchise, and a contract has been signed with the Edison General Electric company, the latter company to build and equip the former's road by August 1st of this year. M.

Louisville, Ky.

LOUISVILLE, Ky., April 25.—The new power house of the Louisville City Railway company, located at the corner of Campbell and Logan streets, has been completed. The machinery, which had been in place for several weeks, was tested on Friday, and found to be perfect. The Fourth avenue, Green street, Shelby street and Main street lines will be operated from this station, and the old station at Seventeenth and Walnut streets will not be used for the present.

The new electric line on Market street will be placed in operation May 1st. The road will be about five miles in length. The motor cars and trailers have been received, and all is ready for the start. The Second street line, owing to the inability of the company to secure a sufficient number of motors, will not be put in operation before the latter part of June or the first of July.

H. J. T. Morrill has contracted with the Edison company for a twenty-five horse power motor to run his printing machinery. Buschmeyer & Lang, jewelers, have also entered into contract with the same company for a motor to drive their machinery. The Edison company has installed two 150 horse power generators in the station of the Highland Electric Railway company of New Albany, Ind. C. C. Y.

Sioux City, Ia.

SIOUX CITY, Ia., April 25.—The Sioux City Electric Street Railway company has had such demands made on the system for motor power that it is compelled to make extensive additions at once. This company will also shortly put in an alternating dynamo to furnish current for incandescent lighting.

One of the subscribers of the Iowa Union Telephone company evidently had a poor working instrument, for after trying hard for some time to get satisfaction he became enraged and smashed the machine into pieces.

Morningside Addition, beside being favored with an elevated road, is to have an electric line at an early date.

The construction work on the Riverside and Highland Park railway is nearly all completed. C. W. Hornick, the president, claims the company will have the road in operation not later than the 15th of May. This is to be one of the best lines built in this section. The Westinghouse company is building the road and equipping it with that company's apparatus.

The Sioux City Electric company has decided to lay four

or five miles of track this summer, and has now in the yards about four miles of construction material. A large gang of men has been busy all week laying a double track between Jackson and Water streets.

Franchises for electric roads are being asked for by different companies, and it is safe to predict that inside of two years every street in the city of any importance whatever will be supplied with this great modern convenience. W. H. T.

St. Louis, Mo.

ST. LOUIS, Mo., April 27.—St. Louis has at the present time nearly one hundred miles of electric street railway lines, and it is expected that nearly as much more will be built this year.

C. H. Holmes, room 410, Commercial Building, has recently filled several very large orders for cedar poles, and reports an active demand from the street railway and electric light companies of St. Louis and the Southwest. Mr. Holmes deals in steel, octagonal pine and cedar poles, cross arms, pins and everything connected with the wooden department of street railway and electric light companies.

The St. Louis Machinery & Supply company has just removed from 611 Pine street to 418 North Third street, the change becoming necessary owing to a rapid increase of business. Chas. Hardesty of this company is also the owner of Flegle's air space covering, which is rapidly coming into use in connection with electric plants. The supply company is handling a line of automatic engines, pumps, boilers, etc., and a very active season's business is anticipated.

PERSONAL.

M. M. M. Slattery was in Chicago this week.

Chief Barrett of the Electrical Department of the World's Fair is in New York.

O D. Cotton, who has for some time been connected with a Detroit firm, has resigned for the purpose of accepting a position with the Hazelton Tripod Boiler company.

NEW INCORPORATIONS.

Chicago Electric Protective company, Chicago, Ill.; capital stock, $100,000; to do business in electrical appliances.

Iron Mountain Electric Light and Power company, Iron Mountain, Mich.; capital stock, $50,000; furnishing light and power by electricity.

The Watseka Electric Light company, Watseka, Ill.; capital stock, $8,000; the furnishing of electric light and power for any and all purposes.

Pecatonica Electric Light & Power company, Pecatonica, Ill., capital stock $10,000, to manufacture and furnish electric light and electric power.

Barraboo, Devil's Lake and Kilbourn City Electric Railway company, Barraboo, Wis.; capital stock, $35,000; building and operating an electric railway.

The Citizens' Electric Railway, Light & Power company, Mansfield, O.; capital stock, $125,000; constructing and operating a street railway and furnishing light and power, etc.

Western Electrical Supply company, St. Louis, Mo.; capital stock, $5,000; to manufacture and deal in electrical, mechanical and optical supplies, fixtures, etc., also patents for same.

Butler Water, Light & Power company, Butler, Mo.; capital stock, $100,000; to furnish waterworks and to own and operate machinery for furnishing light and power both by gas and electricity.

Marshfield Edison Light & Power company, Marshfield, Ore.; capital stock, $30,000; generating and furnishing electric currents and transmission of the same throughout Marshfield and vicinity.

Houston Rapid company, Houston, Tex.; capital stock, $300,000; to purchase, construct, operate and equip an electric street railway and rapid transit in the city of Houston, its additions and suburbs.

Ocean City Light, Heat & Power company, Ocean City, N. J.; capital stock, $40,000; to build and erect gas and electric works for manufacturing, generating, distributing and supplying light and heat by gas and electricity.

Dillon Power & Light company, Dillon, Montana; capital stock, $20,000; to generate, use, furnish, sell, lease, hire, and in any way deal in electricity, and steam power for lighting, heating, manufacturing and mechanical purposes and any and all other purposes for which same may be used.

ELECTRIC LIGHTING.

At Atlanta, Tex., the erection of an electric light plant is talked of.

The Talladega, Ala., Gas, Light & Water company is considering an increase of capital stock.

Audubon, Ia., has contracted for a 750 light central station plant, National Transformer system.

The aldermen of Independence, Mo., have appointed a committee to investigate the question of municipal ownership of an electric light plant.

Electric lighting is steadily increasing in China. At the present time there are some 1,700 incandescent lamps being erected in cotton mills near Shanghai.

In Austria-Hungary there are now 185,000 incandescent and 4,000 arc lamps supplied by 1,200 dynamos.

La Grange, Tex., has decided by popular vote to issue bonds for the installation of an electric lighting system.

Bids are asked by the city authorities of Brussels, Belgium, for an electric plant capable of operating 20,000 lamps.

The recently organized Richlands, Va., Water, Electric Light, Gas & Power company proposes to install an electric light plant.

The Electric Light company of Tokio, Japan, is operating four stations supplying current to more than 11,000 incandescent lamps.

At Baltimore, Md., the Wenstrom Consolidated Dynamo & Motor company has submitted a proposition to light the city hall by electricity.

The following named towns in Spain have the electric light: Valencia, 6,000 lamps; Gijon, 1,000; Albacete, 800; Cuenca, 700; Pampeluna, 550; Talavera, 400; Guadalajara, 70.

The authorities of the city of Glasgow, Scotland, contemplate electric street lighting, but are undecided whether to erect a station of their own or have the work done by contract.

About 14,000 incandescent lamps are connected with the Vienna central station of the General Electric company of Austria, although the plant was only put in operation in September, 1889.

A second electric light exhibition will be held next fall by the directors of the Crystal Palace, London. Every endeavor will be made to render this second exhibition complete and popular. In addition to the various systems of lighting, the exhibits will comprise telegraphs, telephones, signals, batteries, motors, cables, lightning conductors, magneto electric and dynamo-electric machines, and all other apparatus, instruments, machinery, and material connected with the production and transmission of electricity.

An installation of forty arc lamps of 2,000 candle power each, has been erected by the Lancashire & Yorkshire Railway company at Manchester, England, for the lighting of Victoria station. The generating plant consists of three dynamos in an engine house. Two locomotive engines have been adopted, so as to be used for driving the countershaft to which the dynamos are belted. Two only of the dynamos are used at once, the third being held in reserve. Each machine will generate sufficient current for half the lamps in the station. It is intended ultimately to lay down a much larger plant in a more central position, from which the whole of the station, offices and approaches will be lighted.

According to a Washington dispatch, "One of the most serious causes of delay in getting the new vessels of the navy ready for sea is in the electric light plants. This is true at present with the Newark and Concord, both of which should have been ready weeks ago, and nearly all the new vessels now in commission, beginning with the Roach cruisers. The electric plant of the Baltimore has not yet been accepted because of imperfections, and the probabilities are that both the Newark and Concord will go to sea before this part of their equipments is perfected. So much trouble has ensued from this cause that the department has determined to leave this part of the equipments out of future contracts for the construction of new vessels and place it under the direct supervision of the Bureau of Equipment."

A bill has been filed in the Circuit court by several citizens of Rogers Park, Ill., to enjoin H. E. Keeler from operating an electric light plant in Evanston, and to set aside the ordinance authorizing the construction and operation of the plant Some time ago Judge Horton issued an injunction restraining the trustees from making a contract with Keeler under an ordinance then in effect. The board of trustees then passed another ordinance which is claimed to be almost identical with the other, and under the second ordinance is about to sign a contract with Keeler, which, it is claimed, will create an exorbitant tax. It is claimed that the ordinance is void, because passed against the wishes of a majority of the residents of the village, and because bids were not advertised for. It is claimed that the board of trustees is in contempt of court, and it is said that the president will be attacked for violating Judge Horton's injunction.

British legislators are talking of lighting both Houses of Parliament by electricity. A vigorous discussion sprang up in the House of Commons recently, in connection with the vote of £1,900 for oil lamps used in the building. There was a generally expressed opinion that if the annual oil bill could not be reduced it would be a good thing to extend the electric light throughout the building. "Among the many instructive remarks made on this occasion," comments the London *Electrician*, "was one by that champion of accuracy, the senior member for Northampton, who was of opinion that the first commissioner of works would confer a public benefit if he would cause a record to be kept of the cost per hour of each electric lamp, many persons having found the present forms of the electric meter entirely incorrect. The indications of the average electric meter can certainly be relied upon to be true to within one or two per cent. Can as much be said for the statements of the average member of Parliament?"

ELECTRIC RAILWAYS.

The new electric line at Youngstown, O., will soon be opened.

An electric street railway will probably be built at Mason City, Ia.

A franchise has been granted for an electric railway in Alameda, Cal.

Steps are being taken to organize an electric street car company in Greeley, Colo.

The Toledo, O., street railway company has increased its capital stock from $600,000 to $800,000.

It is stated that a company is being formed to construct another electrical railroad at Houston, Texas.

The City Electric Street Railway company of Little Rock, Ark., has increased its capital stock to $500,000.

The contract for the construction of the Asheville, N. C., electric road has been let. The line will be nearly two miles long.

The Baltimore, Md., City Passenger Railway company is investigating the cost of equipping part of its lines with the electric system.

The People's Street Railway company of Charleston, W. Va., has applied to the city council for a franchise to construct an electric railroad.

A petition has been presented for the incorporation of the Quincy Electric Freight Railway company at Boston, with a capital not to exceed $300,000.

The English company which owns the most remunerative system of street cars in Madrid intends to make a trial of electric traction on a level portion of its lines. The company would thus be able to abolish the use of mules, which are a great source of difficulty.

The Thomson-Houston Electric company recently secured an order for an equipment of 20 cars for the consolidated railroad of Columbus. Last week the order was doubled, and the company will soon ship 40 motor cars and the necessary equipment to Columbus. The power plant will consist of a generating plant of 600 horse power capacity; this also to be supplied by the Thomson-Houston company. The contract was closed by W. J. Clark of the Boston office.

The two Edco storage battery cars installed upon the Eckington & Soldiers' Home Railway company's track, in Washington, D. C., March 13th, have given excellent satisfaction, it is said. On Sunday, April 19th, the two cars carried 1,293 registered passengers, besides nearly as many transfers, the cars running on the G and Fifth street branch connecting with the main line of the Eckington road on New York avenue, where the trolley system is used. A fair calculation would therefore give 2,500 passengers as having been carried by the two Edco cars on that date, the greatest number registered on a single half trip being 75 passengers.

The following dispatch from St. Paul was published in several western papers last week: "The passengers on the south-bound electric car on South Robert street, St. Paul, this morning, shortly before 11 o'clock, had an experience that none of them probably care to pass through again. It was raining in torrents, and the car had reached the south end of the bridge which crosses the Kansas City railroad, when suddenly a blinding flash of lightning seemed to envelope the car, and sulphurous smoke filled the conveyance. It at once came to a dead stand-still, and was on fire in an instant. The passengers scrambled out at a lively rate, while the car was in a sheet of flames. All hands turned to extinguish the blaze, and with the aid of the heavy rain which was then falling managed to put it out at last, but not until the car was terribly damaged. The machinery was rendered useless, and the interior badly scorched. The damage will amount to several hundred dollars. Fortunately no one was injured, and all were speedily taken under cover and sent on their journey by means of the prompt action of the street railway company."

The popularity of electric cars, especially upon lines carrying passengers to pleasure resorts, is shown in many reports. According to a Rochester, N. Y., paper the street railway company last Sunday was obliged to increase the number of cars to Charlotte. Before 9 A. M. the Charlotte cars going north were crowded, and later it was necessary to attach old Lake avenue horse cars to the motor cars and to press into service one or two Lyell avenue cars. The steps on the electric cars have been replaced by lower ones. A new engine has been placed in the power house, and three new generators will be put in operation this week. On one or two of the Charlotte cars an electric bell forms the means of communication between the conductor and the motor man. When the west track under the Central railroad bridge on North St. Paul street has been depressed work on the Caledonia avenue and North St. Paul street line will be completed. Electric cars will be put in operation on the Exchange street and Central avenue and the Monroe avenue and Sophia street lines soon. The electric railroad company has strengthened the floor of West Main street bridge by the addition of heavy iron and oak beams.

ELECTRIC MINING.

The Pond Engineering company of St. Louis has just placed in the Osage Coal company's mine at McAllister, I. T., a double Blake pump to be run by electricity. This pump works against a head of over five hundred feet and much trouble has heretofore been had in keeping the packing in place. It is now reported to be working successfully.

Commenting upon the abandonment of the Lake front mining display, recently announced in the WESTERN ELECTRICIAN, the *Mining Review* says: "The electrical people are greatly regretting the abandonment of the underground mining exhibit which E. F. Brown proposed making on the lake front as one of the varied attractions of the World's Fair. They had calculated on using this subterranean enterprise for a magnificent display of electrical lights and appliances."

ELECTRIC MOTOR.

A Boston firm has discarded steam for electric power for operating machinery for sawing structural iron beam,, and drilling holes in the beams.

A bill has passed the New York legislature allowing ex periments on the Erie canal looking toward the employ ment of electricity as a motive power.

At Roanoke, Va., E. B. Fisher is arranging for the organization of a $125,000 stock company to operate portable electric motors and electric light plants according to the patents of the Carpenter Electric Light company of Denver, Colo.

TELEPHONE.

A company has been organized to build a telephone line, forty miles in length, from Lakeport to Ukiah, Cal.

Telephonic communication between Christiana, Norway and Stockholm, Sweden, is likely to be soon established. The telephone line will go from Christiana to the frontier at Magnor. For the Swedish portion of the line the Stockholm-Orebro-Carlstad line will be used, with requisite extension. This arrangement has the advantage of bringing Christiana into connection with several towns in Central Sweden. It is proposed to reserve the line during several hours each day for direct communication between the two capitals.

MISCELLANEOUS.

The St. Pancras, London, electrical exhibition, which had been open daily since March 14, closed on April 1st. During the fourteen days that the exhibition was open over 14,000 people visited it.

The students of the Fort Atkinson High School, who are publishing the *Fort Beacon*, are making a very creditable showing. In a recent issue they presented an interesting article on the operation of an electric plant. The paper is bright and interesting, and its publishers are to be commended for the journalistic ability shown in its preparation.

The interest manifested by the general public in everything pertaining to electricity has led many prominent publications to present popular articles on electrical subjects. The *New England Magazine* recently took up this subject and is now presenting a series of articles of an historical character tracing the development of electrical science and the application of the art. The articles are well written and handsomely illustrated.

Terrific thunderstorms were reported from the East last week. Eastern Connecticut was visited by one. The heavens blazed constantly for an hour with white and yellowish lightning, and the crash of thunder was continuous. A deluge of rain fell, and then came a shower of hail for ten minutes, some of the stones being as large as a hazel nut. Every telephone box in the city was disabled, and the wires were useless for twelve hours.

A Swedish engineer has recently applied electricity to testing steel and iron for hardness. It is well known that an electric current of sufficient strength will fuse a thin slip of metal or wire when passed through it. By making a number of experiments the engineer has found the strengths of current required to fuse test pieces of iron and steel of different degrees of hardness, and has formed a scale of currents corresponding to a scale of hardness. In order to find the hardness of a particular test piece of the metal it is only necessary to find the current required to fuse it, and this can easily be done by means of an ammeter. The corresponding figure on the scale gives the hardness of the piece.

TRADE NEWS.

The Woodbridge & Turner Engineering company, 47 *Times* Building, New York City, has been organized as successor to the firm of Woodbridge & Turner, electrical and mechanical engineers.

The popularity of the Ward arc lamp continues, as is shown by the large number of orders that are received every week. The company reports that during the month of April the sales were greater than in any previous month.

The Shultz Belting company of St. Louis has just closed a contract with the St. Louis & Suburban railroad company for two 72 inch belts each 154 feet long; also ten belts 16 inches wide, aggregating 700 feet. These belts are to be double leather and will be cemented, as no rivets or pegs will be used.

The new Chamberlain hotel at Old Point Comfort will be equipped with Partrick & Carter Co.'s system of annunciators, with fire alarm and return calls. This will require a 600 number instrument with 600 of the P.& C. company's patent combination bells. John R. Galloway of Washington, D. C., has the contract for the work.

At the headquarters of the Crocker-Wheeler Electric Motor company, 430-432 West Fourteenth street, New York, a large force of carpenters and painters are re-arranging and renovating the recently enlarged establishment. The alterations being made are now nearly completed and will give the company very handsome and convenient surroundings.

The Star Iron Tower company of Fort Wayne, Ind., has just issued a catalogue, handsomely illustrated, in which the features of the tower system for electric lighting are presented. Referring to the height most desirable for electric lights, the company says: "In a series of tests, during which we increased the elevation of a group of lights from 75 feet to 175 feet, it was demonstrated that at any height less than 125 feet, the full candle power of a standard or 'nominal' 2,000 candle power arc lamp was not utilized. At an elevation of little more than 150 feet the extreme limit of effective illumination seemed to be reached, and greater altitudes not only did not increase this limit, but lessened the illumination between it and the base of the tower."

Jas. W. Queen & Co., Philadelphia, have issued another catalogue in which attention is called to electrical measuring instruments for the use of students in laboratory work. It has been found that the interest taken in electrical engineering throughout the United States renders it necessary for every school to give at least an elementary course in this branch. This has made a demand for a special line of instruments, which the catalogue, it is claimed, illustrates and describes.

The Interior Conduit & Insulation company has taken possession of its new suite of offices in the Edison building at 42 and 44 Broad street, New York. The offices are on the fifth floor fronting on Broad street. The several rooms are large, well-ventilated and have an abundance of light from all sides. The two large rooms in front are occupied respectively by E. H. Johnson, president, and E. W. Little, general manager, and are furnished simply but substantially in hard wood. E. T. Greenfield, the company's electrician, has his office, draughting and show rooms directly back of Mr. Johnson's office, F. A. Mason with the financial department adjoining.

BUSINESS.

The McGuire Manufacturing company has just closed a contract for supplying new steel trucks for thirty cars to be used by the East Harrisburg, Pa., Electrical Railway company, and also for eighty trucks for the Villard road at Milwaukee.

A. L. Bogart, 22 Union Square, New York, has issued a valuable pamphlet containing complete instructions for the installation and operation of multiple electric gas lighting apparatus. A list of Mr. Bogart's specialties in the line of electric gas lighting is appended.

The Standard Paint company of New York city reports an excellent trade this year and a bright outlook. The company is making large shipments of armature varnish, insulating tape and its well-known compound. The new offices of the company at 2 Liberty street, New York, were occupied May 1st, and will hereafter be the headquarters of the company.

The Chicago Electric Manufacturing company, 73 West Jackson street, Chicago, has recently moved from the third to the second story of the building at this number, securing an admirable factory. When this change took place a large addition was made to the working machinery so that any model or specialty can be built at short notice. This company is also prepared to manufacture any standard electrical device or appliance. It also carries a large stock of copper bars and rods in all sizes and a full stock of insulating material, which will be cut to any shape desired for inventors and model makers. The word "Reliable" is the motto of this company.

Freeman, Coleman & Co., 53 and 55 South Jefferson street, Chicago, is the name of another new firm that has entered the field for a share of the electrical business. Clyde Coleman, the junior member of the firm, has invented a number of specialties that appear to have considerable merit. These devices will be manufactured by the company. Among Mr Coleman's recent inventions, and one on which he has received several letters patent, is a very ingenious electrical device, or more properly a magnetic device, for fastening on shoe buttons. By means of a permanent magnet the loose buttons are picked up and carried to the desired point. Mr. Coleman has also perfected a dry battery, which it is claimed has a high efficiency, and is now at work on a small motor that will soon be placed on the market. This firm is also prepared to do repair work or to assist in the perfecting and manufacturing of other specialties.

There has been a demand for an arc lamp that would burn steadily, giving a reasonably high candle power on an incandescent circuit. This demand has come principally from large establishments owning an isolated incandescent plant, the fact appearing after such plant has been installed either that the lights have not been properly distributed or that in some large room or space with high ceilings the incandescent lamps are too far away to be effective. To remedy this defect an arc lamp must be resorted to and the Mosher Arc Lamp company, 125 Ontario street, Chicago, claims to have perfected its lamp so that it renders an entirely satisfactory service. The demand for these lamps during the last two or three weeks being far in excess of the capacity of the factory, plans for a new factory on a large scale are being prepared. Ground in a Chicago suburb will be purchased, and the factory built before the close of the present summer.

ELECTRICAL PATENTS.

Issued April 21, 1891.

450,605. Socket for Incandescent Lamps. George H. Alton, Lynn, Mass.

450,613. Electric Railway. Frank S. Culver, Eau Claire, Wis.

450,615. Means for Communicating Information. Patrick B. Delany, New York, N. Y.

450,626. Safety Device for Overhead Electric Wires. Max Kerstein, Boston, Mass.

450,628. Wall Socket for Incandescent Electric Lamps. Philip Lange, Pittsburg, Pa.

450,630. Printing Telegraph. Samuel R. Linville and Louis F. Hettmansperger, Philadelphia, Pa.
Of the one hundred and sixty-three claims the one hundred and fifty-third is given:
"In a printing telegraph system, a key-board provided with two series of keys adapted to maintain a closed line circuit, adjacent keys of both series electrically connected with each other, and one series constructed so as to break said line and the other adapted to interpose resistance in said line."

450,631. Printing Telegraph. Samuel R. Linville, Philadelphia, Pa.

450,639. Electric Motor or Generator. John F. Seiberling, Akron, O.
The invention relates to the construction of the pole pieces of the field magnets in two parts, adjustable one relative to the other and having faces adjustable at the side of the armature.

450,641. Self-Exciting Alternate Current Electric Generator. William Stanley, Jr., Great Barrington, Mass.
The object of the invention is to provide means for regulating the current automatically and maintaining a constant or an increasing or decreasing difference of potential upon the work circuit, as may be desired, throughout variations of load.

450,645. Railroad Signaling Apparatus. John D. Taylor, Piketon, O.

450,646. Electric Railway Block Signal. John D. Taylor, Piketon, O.
The object of this invention is to place the control of trains on any system of blocks in the hands of one man, who will have an efficient means of knowing the exact location of all trains, and consequently will know just what signals to give to following trains.

450,652. Electric Locomotor. George Westinghouse, Jr., Pittsburg, Pa.

450,683. Trolley or Traveler for Electric Railways. Sidney H Short, Cleveland, O.

450,687. Railway Gate Crossing for Overhead Lines. Elihu Thomson, Lynn, Mass.
We give the first claim:
"The combination, with a railway-gate, of an electric line conductor crossing the path of said gate and provided with a removable bridging section actuated by an electro-magnet and circuit connections for operating said electro-magnet."

450,690. Clamp-Electrode for Electrical Dental Apparatus. Thomas S. Wilson, Chicago, Ill.

450,706. Electric Bell-Pull. Lemuel B. Tinkham, Boston, Mass.

450,708. Insulator. Theodore Creighton, Tiffin, O.

450,731. Steam Engine Indicator. Frederick Sargent, New York, N. Y.

450,734. Electric Cable. William I. Bunker, La Grange, Ill.
The invention consists in forming the cable of many separate and individual parts or particles insulated from each other, except at their poles or points of contact, arranged in a series, and retained in such series by any suitable means.

450,742. Electrical Propulsion of Vehicles. Edward H. Johnson, New York, N. Y.

450,744. Power Transmitting Device for Electric Railways. Edward H. Johnson, New York, N. Y.

450,834. Method of Making Plates of Secondary Batteries. Stanley C. C. Currie, Philadelphia, Pa.

450,839. Method of and Apparatus for Covering Electric Wires. Jabez E. Walcott, Providence, R. I.
The second claim reads as follows:
"An improved method of forming covers or sheaths for wires, the same consisting in bending a soft metal strip partially around the wire or wires and forming raised edges or lips thereon, then burning or fusing said lips, and finally rolling down said fused lips, as set forth."

450,840. Galvanic Battery. Charles Willms, Baltimore, Md.

450,846. Insulated Electric Car. John Stephenson, New York, N. Y.

450,853. Trolley Wheel Support for Electric Cars. Harold A. Webber, Passaic, N. J.

450,872. Electric Valve Controller. Charles B. Reardon, Franklin, Pa.

450,875. Electrically Propelled and Steered Torpedo. Winfield S. Sims, Newark, N. J.

450,896. Thermostat. Jesse C. Sims, Maynard, Mass.

450,923. Electro Magnetic Apparatus. Leonidas G. Woolley, Grand Rapids, Mich.

450,927. Automatic Electric Valve-Controller. Ferdinand E. Chatard, Baltimore, Md.

450,966. Electro Magnetic Apparatus for Operating Stop Watches. Frank A. Matthews, Providence, R. I.

450,970. Electric Motor Mechanism. Samuel E. Mower, New Haven, Conn.

450,973. Electric Switch. John A. Norton, Bridgeport, Conn.

450,975. Dynamo Electric Machine or Motor. Albert L. Parcelle, Boston, Mass.
Claim two is given:
"The combination, of a fixed hub or frame carrying the field poles, the surrounding ring-armature having multiple coils, and the casing surrounding and carrying the armature and interlocking and rotating therewith."

450,985. Electric Current Regulator. Joseph A. Williams, Cleveland, O.

450,991. Ceiling Rosette for Incandescent Lamps. David J. Cartwright, Boston, Mass.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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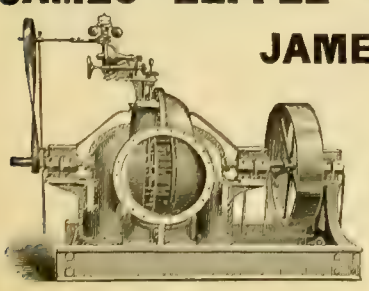

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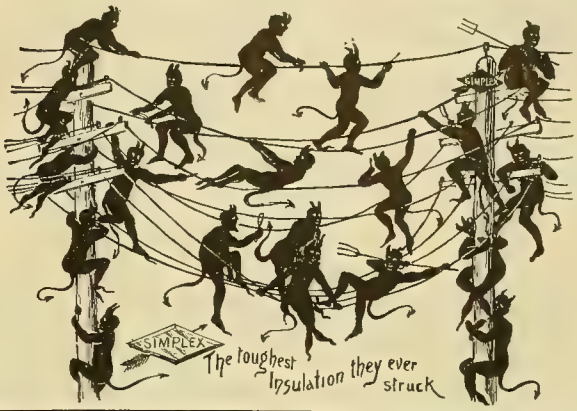

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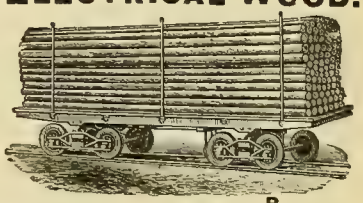

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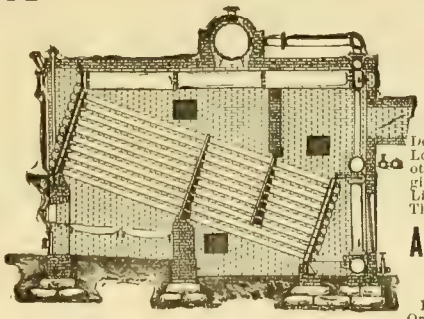

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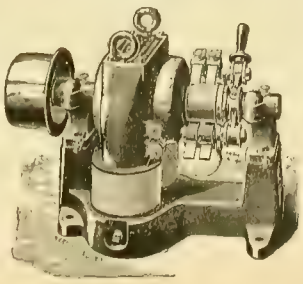

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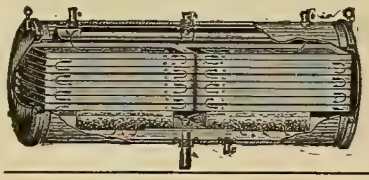

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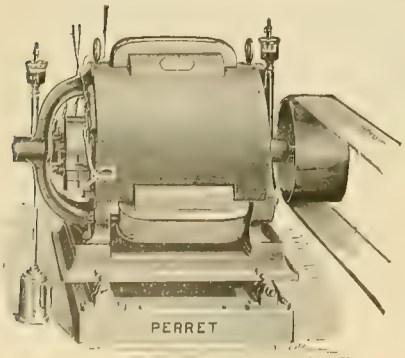

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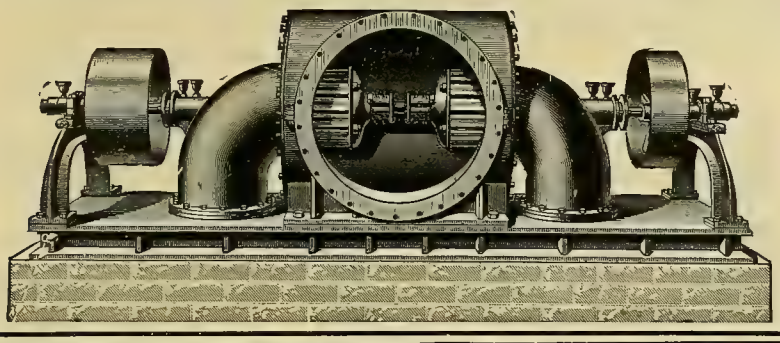

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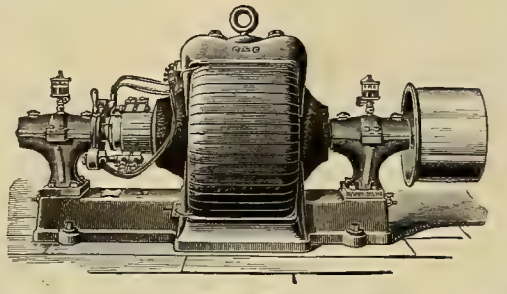

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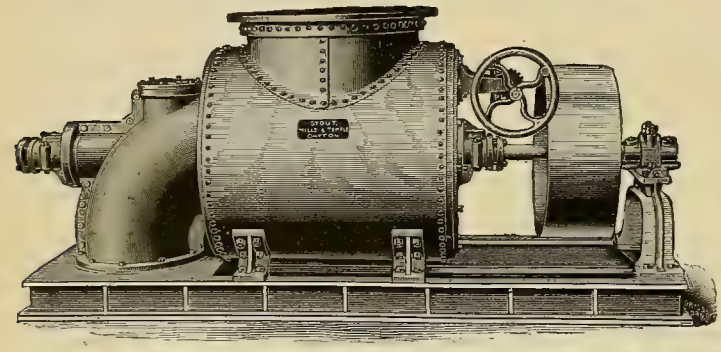

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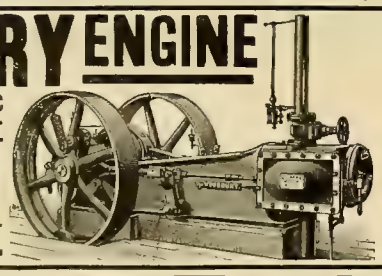

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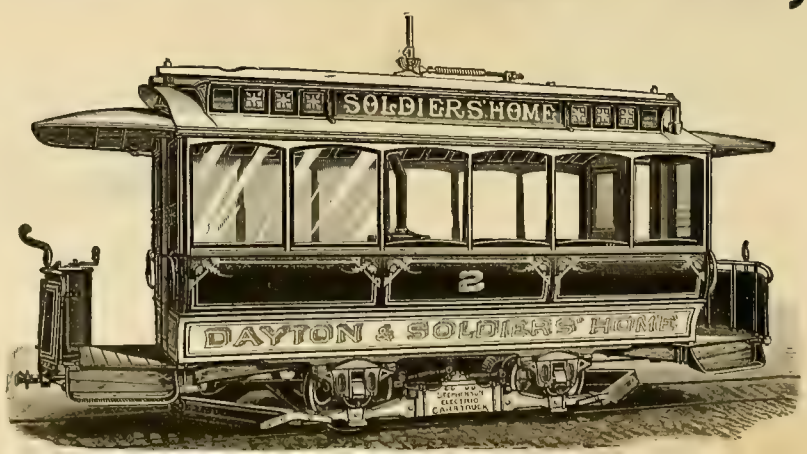

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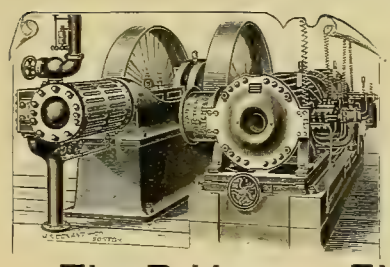
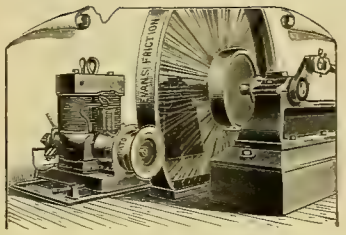
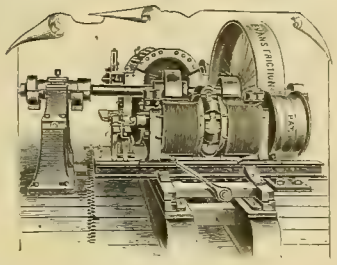

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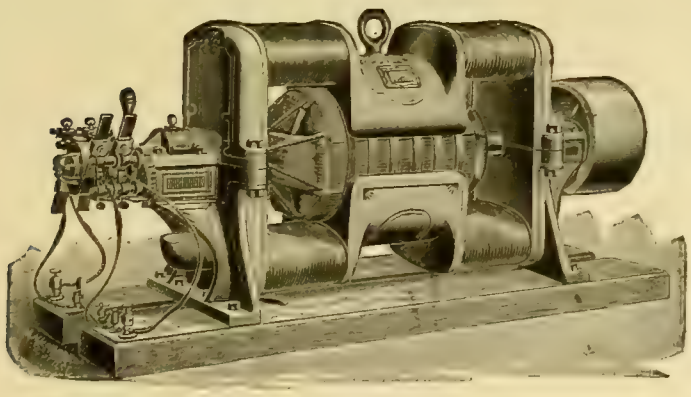

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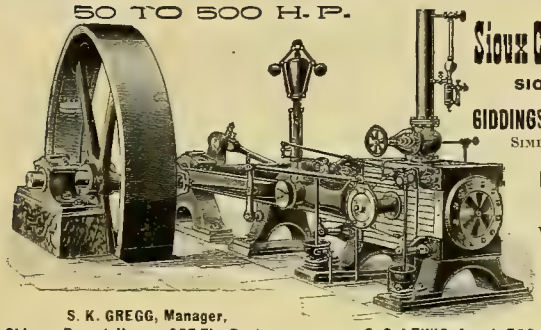

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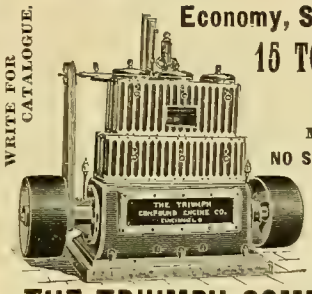

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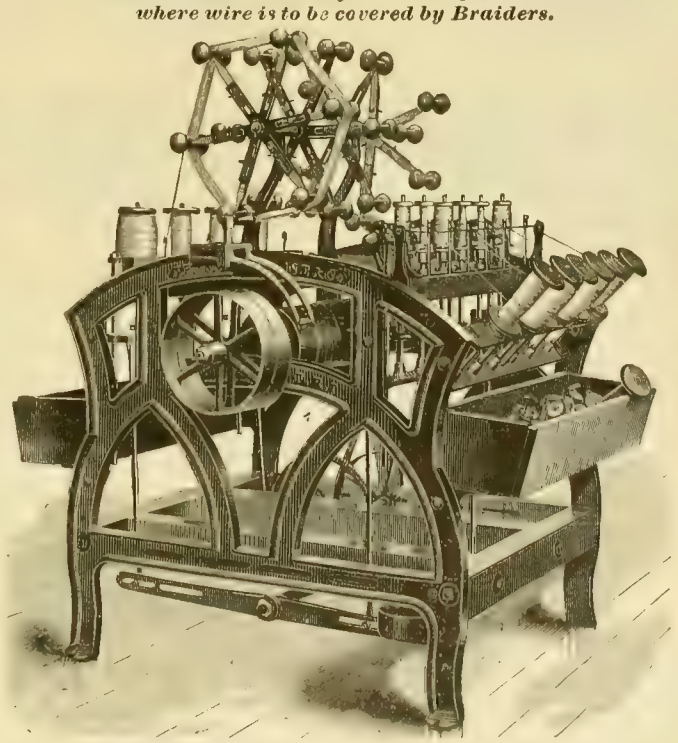

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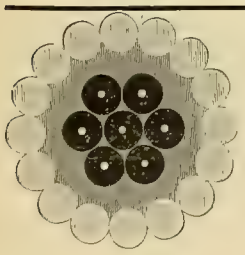
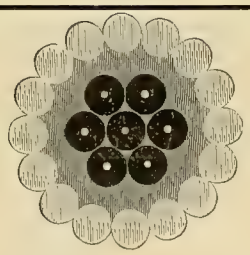
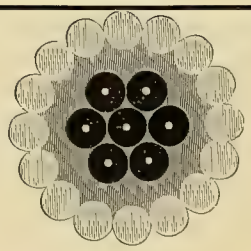
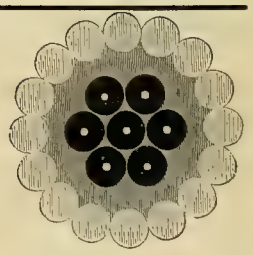

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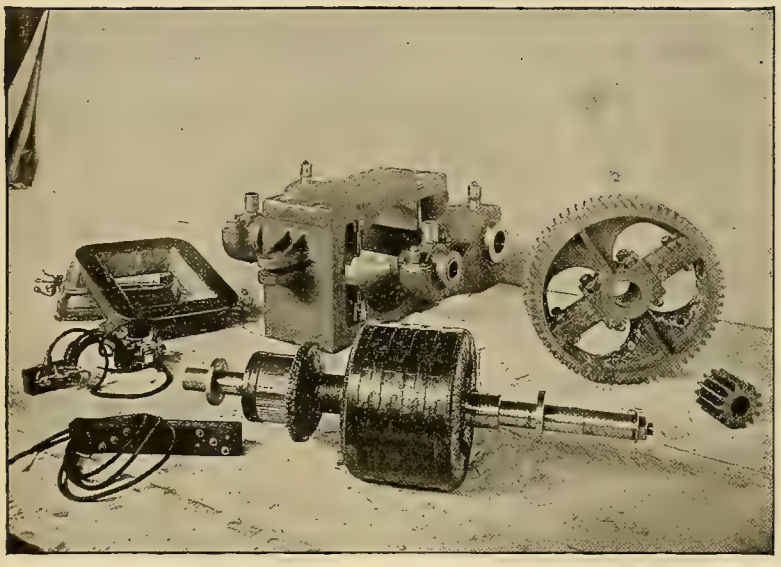

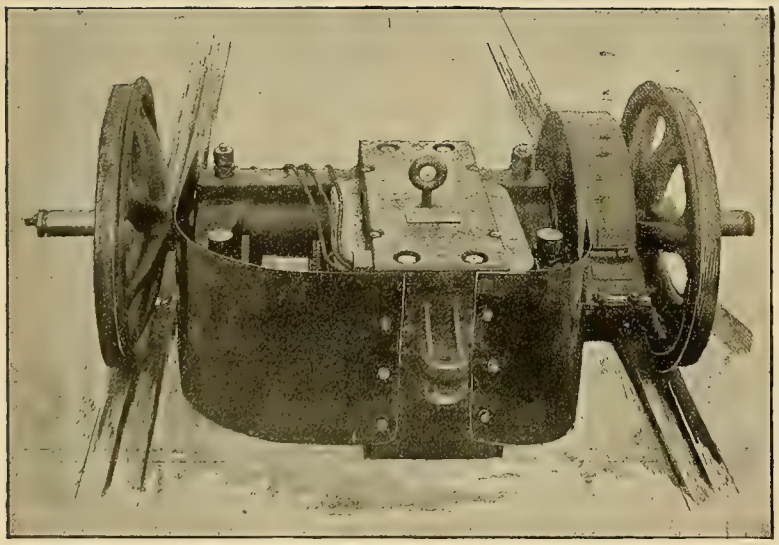

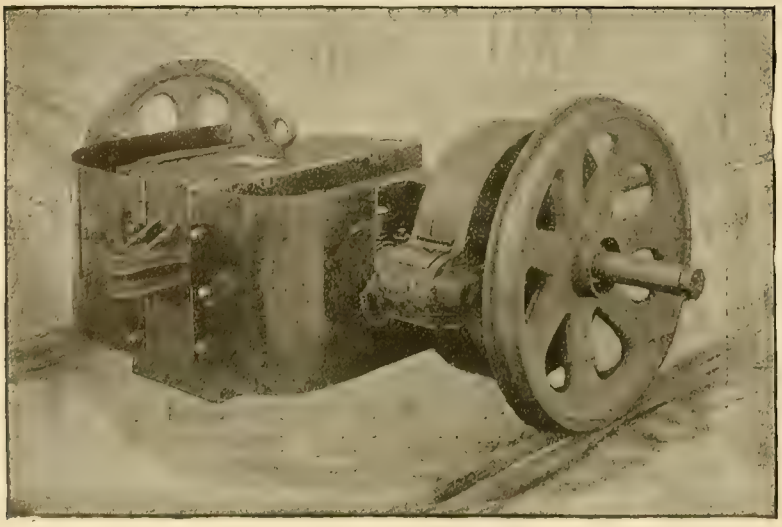

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THE MOST PERFECT OF ANY.

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Vol. VIII. CHICAGO, MAY 9, 1891. No. 19

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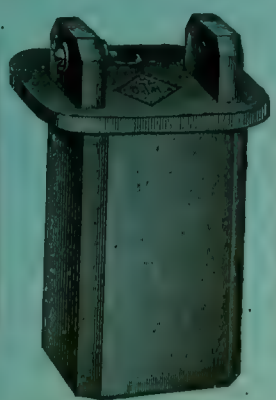
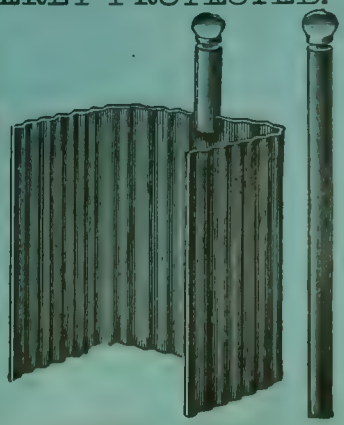
Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.

THE TRADE WILL BE PROPERLY PROTECTED.

Complete Cell of Champion Battery.



Carbon Reservoir and Cover of Champion Battery.



Corrugated Zinc of Champion Battery.

Rod Zinc of Champion Battery.

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5 AND 7 DEY STREET, NEW YORK.

Manufacturers, Importers and Dealers in

Electrical Supplies

OF ALL DESCRIPTION.

Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.

STANDARD ELECTRICAL MEASUREMENT APPARATUS.

NOTE THE CONTRAST!!

INCANDESCENT LIGHTS

In Central Stations July 1st, 1890.

THOMSON-HOUSTON SYSTEM.		Aggregate of All Other Systems.
4,150	VERMONT,	2,200
12,800	TENNESSEE,	1,485
1,500	SOUTH CAROLINA,	NONE.
18,450	TOTAL,	3,685

FIVE TIMES as many of the Thomson-Houston System as of

ALL OTHERS COMBINED.

The figures referring to "total of all systems," taken from table published in August number of "Electrical Industries," for year 1890, are of undisputed accuracy.	Total of all systems.	Thomson-Houston System.	
		Number.	Percentage to total of all systems.
Vermont, - - - -	6,350	4,150	$65\frac{3}{10}$ per cent.
Tennessee, - - - -	14,285	12,800	$89\frac{1}{2}$ per cent.
South Carolina, - -	1,500	1,500	100 per cent.

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115 Broadway, New York City.
15 First Street, San Francisco, Cal.
831 New York Life Building, Kansas City, Mo.

148 Michigan Avenue, Chicago, Ill.
405 Sibley Street, St. Paul, Minn.
215 West Fourth Street, Cincinnati, O.
1110 Noble Street, Philadelphia, Pa.
1333 F Street, Washington, D. C.
115 North 3d Street, St. Louis, Mo.

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Accumulators.
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Brush Electric Co.

Aluminum.
Cowles Electric Smelting & Refining Co.
Cleveland Aluminum Co.
Freeman, Coleman & Co.

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Holtzer-Cabot Electric Co.
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Partrick & Carter Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

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Turner Brass Works.

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Bain Electric Mfg. Co.
Brush Electric Co.
Easton Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
McLaughlin, Jas.
Mosher Arc Lamp Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Bunnell & Co., J. H.
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Crosby Electric Co.
Electrical Supply Co.,The.
Fletcher & Fletcher Electric Co.
GreatWestern Electric Supply Co.
Leclanche Battery Co.
Mason, Jas. H.
Monitor Electric Co.
North American Electric Co.
Partrick & Carter Co.
Queen & Co.
Southern Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

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Butler Hard Rubber Co.
Central Electric Co.
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Holtzer-Cabot Electric Co.
Partrick & Carter Co.
Queen & Co.
Stanley & Hall.
Western Electric Co.

Bells, Electric.
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Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Hay Mfg. Co., Walter.
Knapp Electrical Works.
Monitor Electric Co.
Northwestern Elect. Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Wollensak, J. F.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Empire City Electric Co.
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Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.
Standard Electrical Works.
Stanley & Hall.
Star Electrix Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shults Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.
Pond Engineering Co.

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Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

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Electrical Supply Co., The.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co.,The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Electrical Works.

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(See Wire Insulated.)

Cable, Electric, (See Wire Insulated), **Copper, Sheet and Bar.**
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Western Electric Co.

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Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
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Stephenson Co., John.

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Hill Clutch Works.

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Electric Construction & Supply Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Chicago Electric Mfg. Co.
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Shawhan Machine Works.
Temple, J. C.
Western Electric Co.
Wilson, Rebenstock & Co.

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Chicago Electric Mfg. Co.
Edison General Electric Co.
Electrical Engineering Co.
Engineering Equipment Co.
Hutton, Henry.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Temple, J. C.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
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Edison General Electric Co.
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Great Western Electric Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Roebling's Sons Co., Jno. A.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
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Monitor Electric Co.
Southern Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
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Electrical Supply Co., The.
Empire City Electric Co.
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Great Western Electric Supply Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Paiste, H. T.
Partrick & Carter Co.
Southern Electrical Supply Co.
Star Electrix Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
Colburn & Co., I. W.
Easton Electric Co.
Electrical Engineering Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Howard & Co., Hiram M.
Heisler Electric Light Co.
Little & Co., F. P.
National Electric Manufacturing Co.
Schuyler Electric Co.
Shawhan Machine Works.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Star Electrix Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Specialties.
Cutter, Geo.
Hipwell Mfg. Co., H. H.
Northwestern Elect. Specialty Co.
Turner Brass Works.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Engineering Equipment Co.
Pearson & Co., W. B.
Pond Engineering Co.
Sioux City Engine Works.
Stearns Mfg. Co.
Taylor Manufacturing Co.
Triumph Compound Engine Co.
Westinghouse Machine Co.

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Braun Illustrating Co.

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Evans Friction Cone Co.

Gas Lighting, Electric.
Cleverly Electrical Works.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.
Wollensak, J. F.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Automatic Switch Co.
Brush Electric Co.
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Chicago Electric Mfg. Co.
Cleverly Electrical Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Holmes, Booth & Haydens.
Holtzer-Cabot Electric Co.
International Okonite Co., The.
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Ostrander & Co.,W. R.
Partrick & Carter Co.
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Stanley & Hall.
Star Electrix Co.
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Western Electric Co.
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Monitor Electric Co.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Paint Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Interior Conduit & Insulation Co.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
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Insurance.
Electric Mutual Insurance Co.

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Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Buckeye Electric Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
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Knapp Electrical Works.
Lennon, J. M.
Monitor Electric Co.

Lamps, Incandescent—Contd.
Sawyer-Man Electric Co.
Southern Electrical Supply Co.
Sunbeam Incandescent Lamp Co.
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India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
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Partrick & Carter Co.
Standard Electrical Works.
Western Electric Co.

Telephones, Electric.
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Western Electric Co.

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Knapp Electrical Works.
Queen & Co.
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Wrigley, T.

Transformers.
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Westinghouse Electric & Mfg. Co.

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Dayton Globe Iron Works Co.
Hunt Machine Co., Rodney.
Leffel & Co., James.
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American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.
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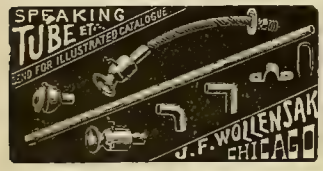

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EFFECTIVE,
SIMPLE,
COMPACT,
PORTABLE.

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87 and 89 South Fifth Avenue, - - NEW YORK.

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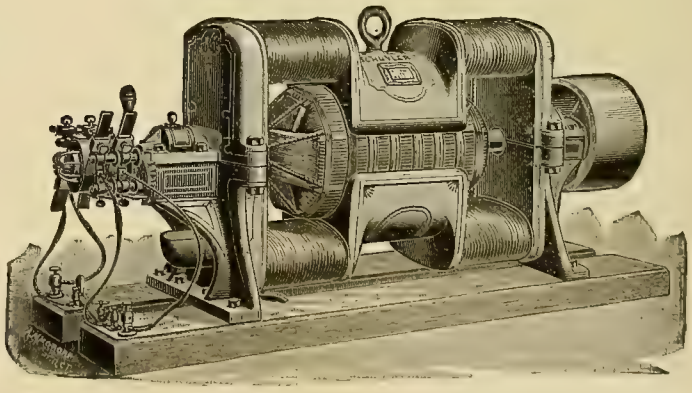
SYSTEM OF

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



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Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

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MIDDLETOWN, CONN.

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For Arc or Incandescent Circuits.

CHEAPEST, BEST, MOST EFFICIENT.

Can be run singly or in series on incandescent circuits. Write for particulars.

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A Full Line in Stock.

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STEEL RAILS.
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RAIL BONDS.
CONSTRUCTION MATERIAL.
Estimates for Cars on Application.

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190 & 192 FIFTH AVE., CHICAGO.

AND STILL THEY COME.

Among our late sales are

38 "WARD" ARC LAMPS

TO THE CENTRAL R. R. OF NEW JERSEY.

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TO THE H. B. CLAFLIN COMPANY OF NEW YORK.

SATISFACTION GUARANTEED.

In Corresponding Please State Voltage and System.

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—MANUFACTURED BY—

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Standard Side, Center and "Pull-Off" Poles. Special Attention Given to Insulation. Special Poles of any Required Length, or to Stand any Strain Made to Order.

Adopted by all the Leading Roads and Recommended by the Best Engineers.

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Over 6,000 Ordered in the Last 3 Months.

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It don't matter whether the Station is great or small, good or bad, since the advent of the

ELECTRIC MUTUAL INSURANCE COMPANY

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It is no use! Why didn't they do it before the Electrical industries were forced to organize their own company—the *ELECTRIC MUTUAL?*

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We have taken $6,000,000 on good Electric Light, Power and Railway Plants since May 15, 1890, and only $100 loss. We take insurance on outside construction, cars, motors, car houses, also good Gas Plants.

I am agent for Companies that insure Liability of Employers for injury to *ANY PERSON* employe or others, in the Station or outside, from electrical accident or others. Damage to property or injury to person by boiler explosion or rupture. Loss of income by stoppage of dynamos, in consequence of fire. Insurance on construction machinery and supplies from time of shipment, during transit, and until installation is accepted. Apply direct. *WE DON'T HAVE AGENTS.*

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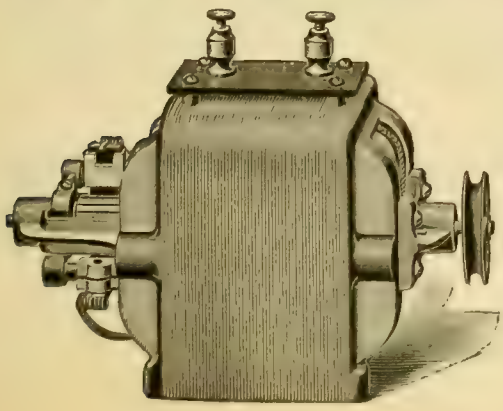

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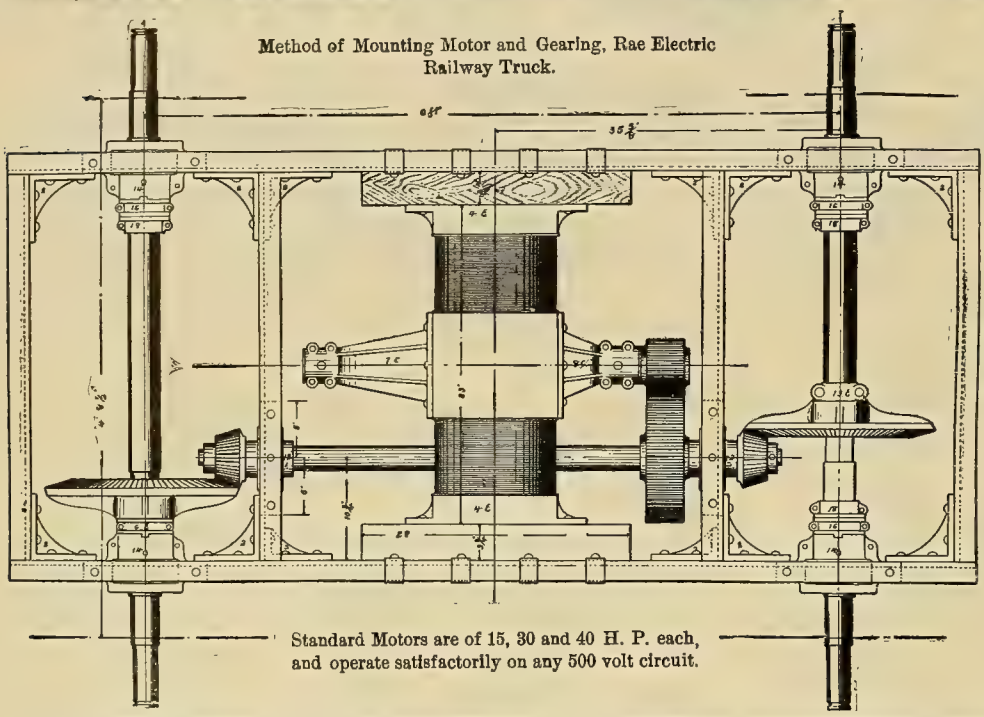

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VULCANIZED INDIA-RUBBER Cables, to any Specification up to 8,000 Megohms per mile.

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CABLES of High Insulation and Long Life, all milage.

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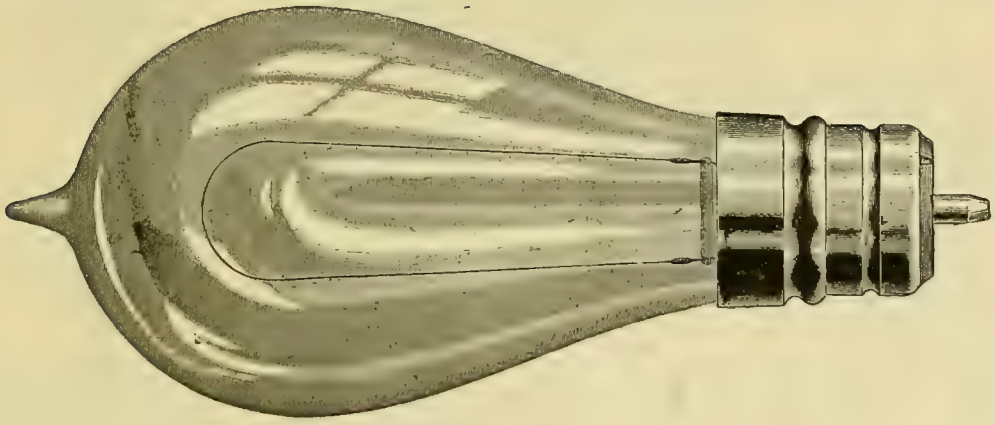

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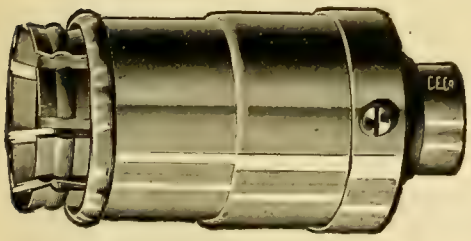

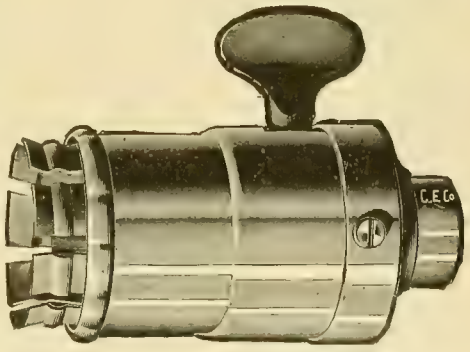

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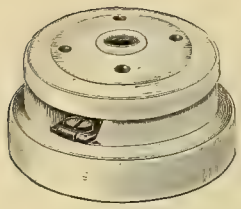

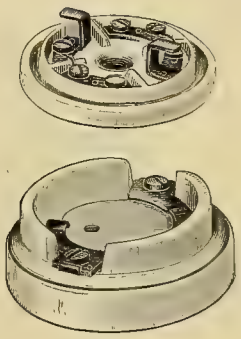

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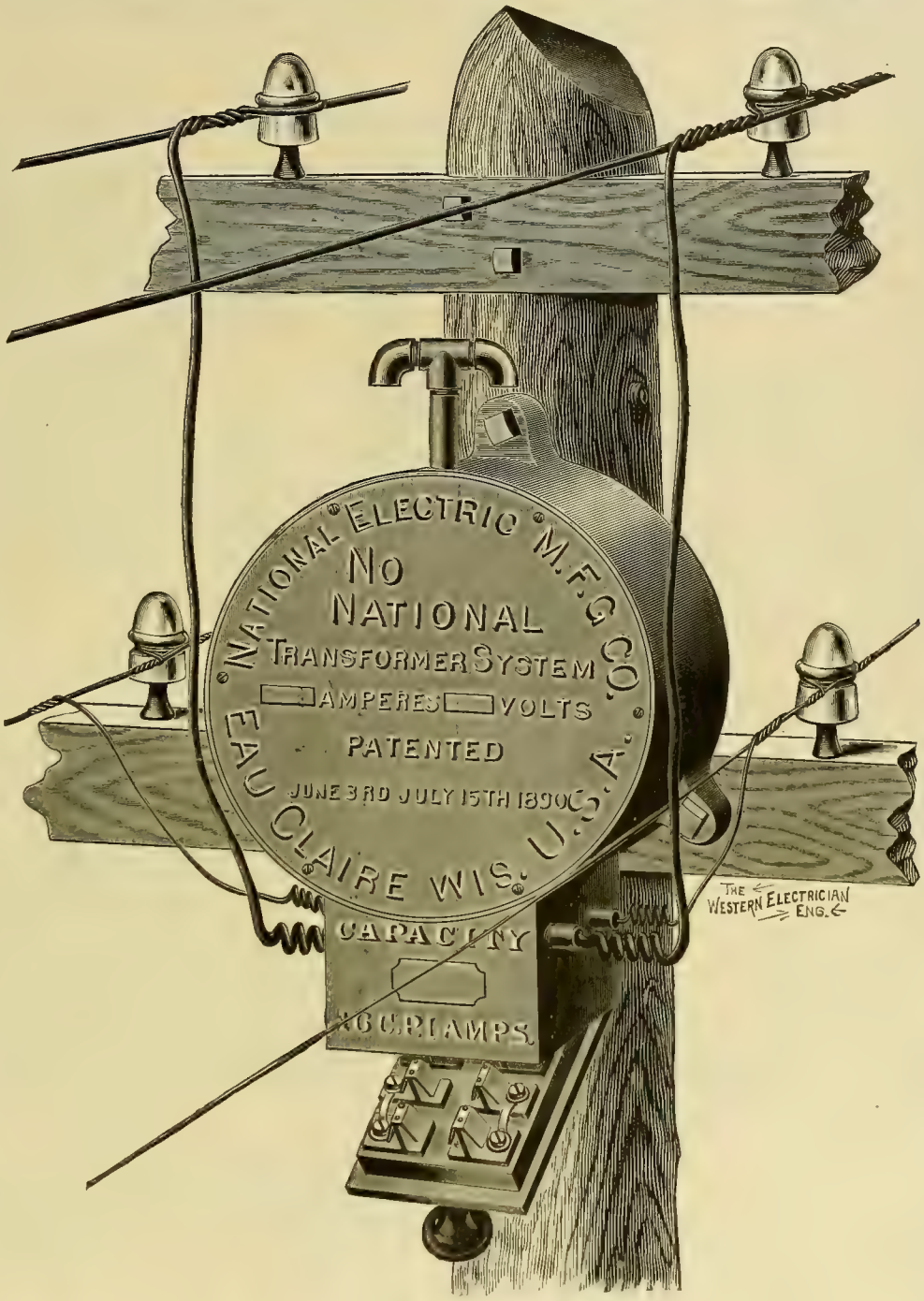
CONVERTER EFFICIENCIES.

It Will PAY YOU to throw out your present transformers and substitute OUR MAKE.

No more Accidents from Grounded Circuits.



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SAN FRANCISCO, CAL.,	National Electric Development Co.
KANSAS CITY, MO.,	Thomas Wolfe, 515 Main St.
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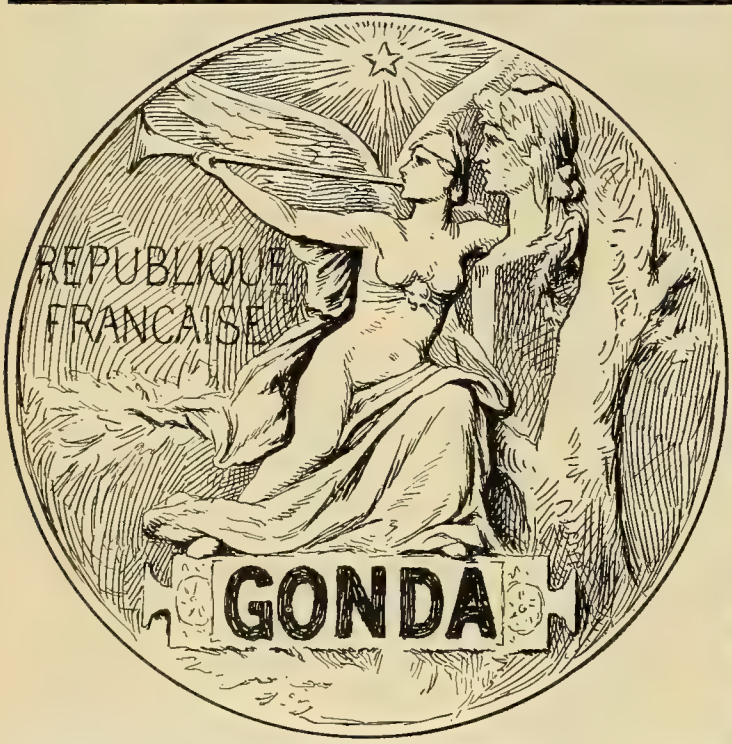

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Burns singly or in series.
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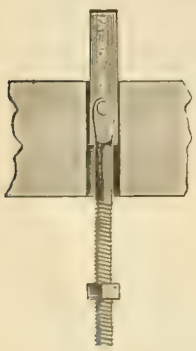

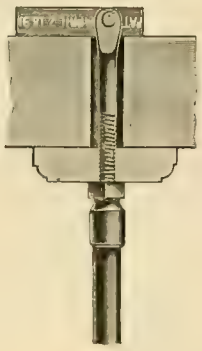

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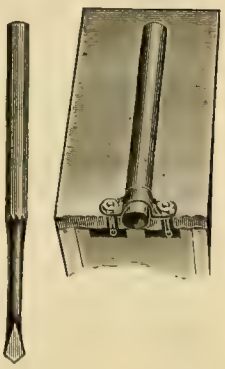

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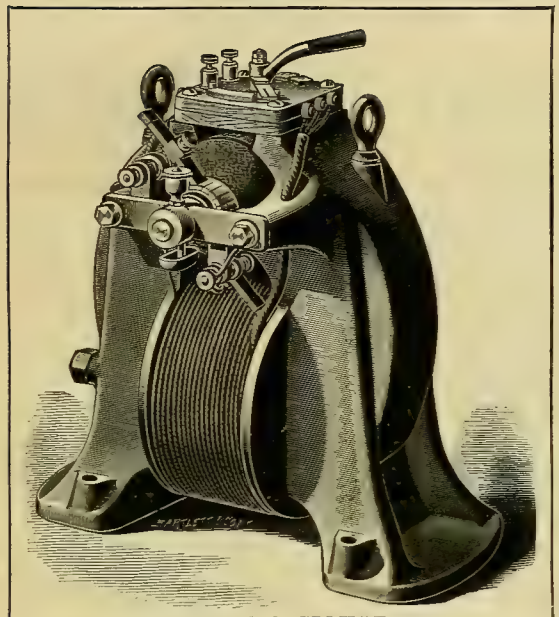

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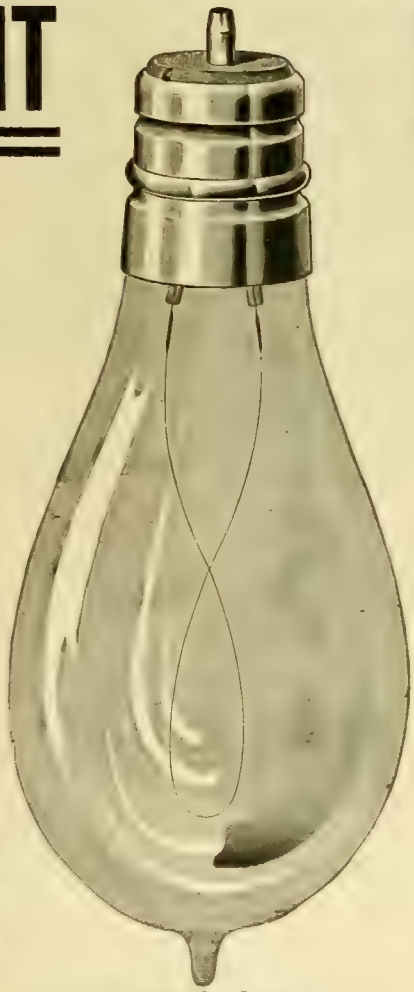

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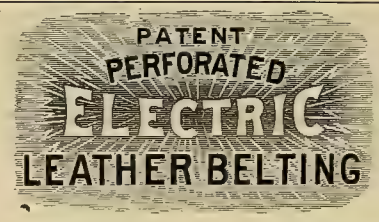

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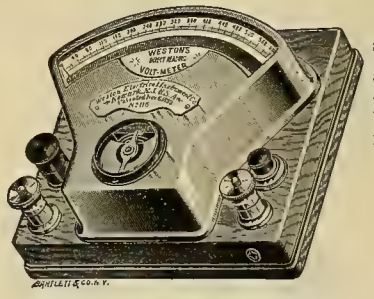

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THEY COST NOTHING.

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Western Electrician.

EVERY SATURDAY.

Vol. VIII. CHICAGO, MAY 9, 1891. No 19

Edison Plant at the Woonsocket Rubber Company's Works.

The Woonsocket Rubber company, Woonsocket, R. I., recently completed its new Alice Mill, having a capacity of 30,000 pairs of shoes per day. The electrical equipment was made by the Edison General Electric company, and consists of two Edison compound dynamos, each having a capacity of 540 16-candle power lamps, and one compound dynamo having a capacity of 180 16-candle power lamps, giving a total capacity of 1,260 lights. A view of the dynamo room is presented in the accompanying illustration. The larger machines are operated by the main shafting, while the smaller, which is used for the night circuit only, is operated by an Armington & Sims engine.

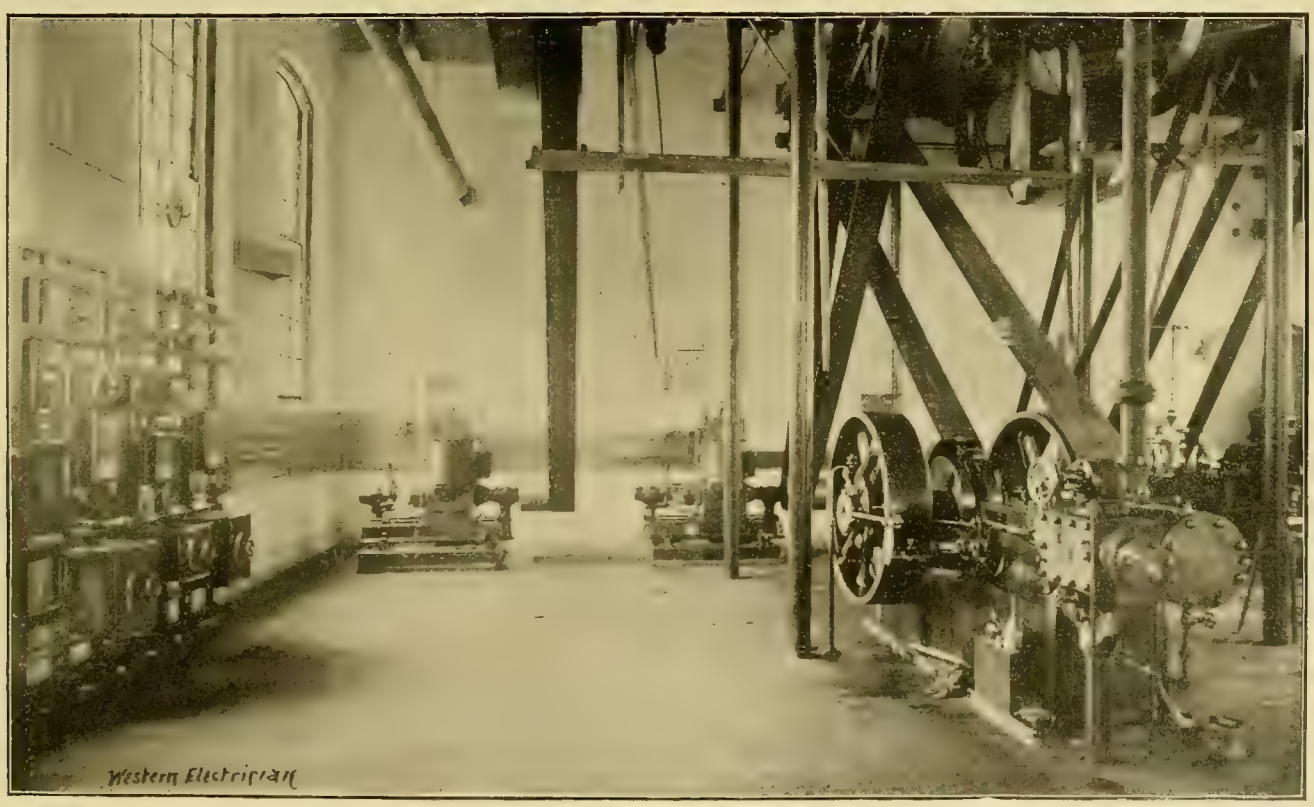
The wiring is a departure from the usual method of mill work, and has excited favorable comment among members of the electrical fraternity who have seen it. According to an expert, "it is better than most parlors are wired." Porcelain insulators are used, and they are applied in a unique way, as the wires are run between the insulators, four of them taking the place of a cleat.

The mains and feeders are run through the beams, a conduit tube being first inserted. The ends are then finished off with a turned button and compound.

The mill is divided into three sections, each having its individual circuit. The object of this is that in case of a fire in either part, it would not affect the working of another.

The office, which is some distance from the main building, is connected to it by an underground conduit through which lighting and telephone wires are run, and also the pipes for water and steam heating purposes. Upon the completion of the plant, it was given a most thorough test, the dynamos for a time carrying upward of 1,400 16-candle power lamps.

The switch-board is particularly simple and very efficient, it being arranged to afford the greatest possible facility in operating the plant.



EDISON PLANT AT THE WOONSOCKET RUBBER COMPANY'S WORKS.

The Trolley System in Brooklyn.

Chairman Rogers and Messrs. Rickard and Baker of the New York State Board of Railroad Commissioners have been considering the applications of the Atlantic Avenue Railroad company and the Coney Island & Brooklyn Railroad company for permission to substitute the electric trolley system for animal power. Property owners along the proposed routes protested against granting the application of the Coney Island & Brooklyn company on the ground that the trolley system was dangerous to life, depreciated property and was a nuisance.

President Brower of the Park Commission said there was only one place left to drive in the city, and that was the park. If these franchises were granted the plaza would be destroyed for driving purposes, and a monstrous outrage perpetrated. Park Commissioner Luscomb said that no cars should be allowed to pass the plaza with any other motive power than horses. The experiment would be too dangerous a one to be tried. If the cars were propelled by electricity it would frighten the horses.

Chairman Rogers said it should be borne in mind that some cities permitted electric wires whose voltage was much greater than that of the electric railway. The state commission would not give, and had not given, permission for the erection of any trolley system where the wires were not protected so as to prevent contact with telephone and electric light wires. It was true that at first the horses were frightened by the trolley, but they soon got used to it. Gen. Henry W. Slocum, the president of the Coney Island & Brooklyn road, said his electric road down the boulevard to Coney Island had been in operation one year, and he had yet to hear of the first accident due to fright of horses. Electric cars ran past the state capitol in Albany and national capitol in Washington, and no accidents had occurred from any such cause. It was all rot to urge such objections. The simple truth was that 99 per cent. of the people were in favor of the proposed system.

The application of the Atlantic Avenue company was then taken up, and substantially the same arguments were used for and against the system. President Richardson, Lawyer Boardman and several electrical experts spoke in defense of the trolley system. The hearing will be continued.

The subject is attracting much attention in New York as well as in Brooklyn. The objections raised to the substitution of electricity for horses are the time-honored complaints about poor construction and danger to life. There is no reason to-day why the electric railway system should not be properly constructed. Yet the fact remains that the companies desiring to adopt improved methods to-day are made to suffer through the short-sighted policy of the pioneers in the business.

Process of Manufacturing Accumulator Grids.

In the manufacture of grids for storage battery plates it has been customary in many cases to melt the lead or an alloy, such as a mixture of lead and antimony, or lead, antimony and mercury, and then to pour it from a ladle into a mould. This method in practice possesses several disadvantages. For instance, if lead alone is employed the surface of the molten metal running into the mold becomes oxidized by contact with the atmosphere, and this dross, becoming diffused throughout the grid, materially lessens its life. If an alloy of lead, such as a mixture of lead and antimony, is the material employed, the molten mass becomes chilled and hardened before it has time to completely fill the mould. In both cases the dross collects upon the surface of the molten metallic mass, and is apt to be dipped up in the ladle and poured into the mould.

With the object of overcoming these difficulties Henry H. Lloyd of Camden, N. J., has devised a process by which he claims to be able to produce a grid of tough and dense metal, and one that is free from defects due to dross.

The process consists in preparing and forming the active material into a plate in a suitable receptacle and then applying to it the metal in a fluid state under a heavy pressure, by means of compressed gas.

Mr. Lloyd takes a salt of a metal, as chloride of lead, and to this he adds the salt of another metal, as chloride of zinc, but any other metallic salts may be employed for the composition of the mass. The mass is then fused in a crucible and formed into crystallized plate by pouring the fused mass into a two-part mould and allowing it to cool and assume a crystallized form. One of the cast crystallized plates is placed in a second mould and lead, or lead and mercury, or other metallic material in a molten state, is forced into and around the plate in the mould under a heavy pressure by means of compressed gas. By this action it is claimed the molten mass becomes instantaneously and firmly attached to the plate in the mould, forming a tough and compact grid free from oxides. Both the process of casting the metallic salts or chlorides and of casting the grid may be conducted in the same mould, as will be readily understood.

The cuts presented herewith are a diagrammatic representation of the apparatus employed by Mr. Lloyd.

A, Figs. 1 and 2, is a crucible set in a furnace *B*. The furnace *B* is provided with a grate and a flue for conducting away the products of combustion. The cylinder *C* is screwed into a cap *c*, resting upon the bottom of the crucible *A*. The cap *c* is provided with a delivery pipe leading to the mould *I* and with a nipple adapted for the reception of a ball valve *D*. The ball valve *D* is located near the bottom of crucible *A*. *E* is a gasometer which communicates with a gas generating apparatus not shown in the cut. *F* is a force pump operated by means of a belt, and used for drawing gas from the gasometer *E* and forcing it under pressure into the holder *G*, where it is stored for use. 1 is a pipe communicating with the interior of the receiver, and with the suction side of the pump *F* for drawing off the gas from the gasometer; 2 is a pipe communicating with the forcing side of the pump *F* and with the interior of the holder *G* for delivering gas under pressure; 3 is a pipe provided with a pressure gauge and a three-way cock *H*, and communicating with the holder *G* and cylinder *C*; 4 is a pipe communicating with the three-way cock *H* and with the receiver; 5 is a nozzle adapted to be fitted into the mould *I*. *L* is a hand lever adapted to retain the sprue of mould *I* in close contact with nozzle 5.

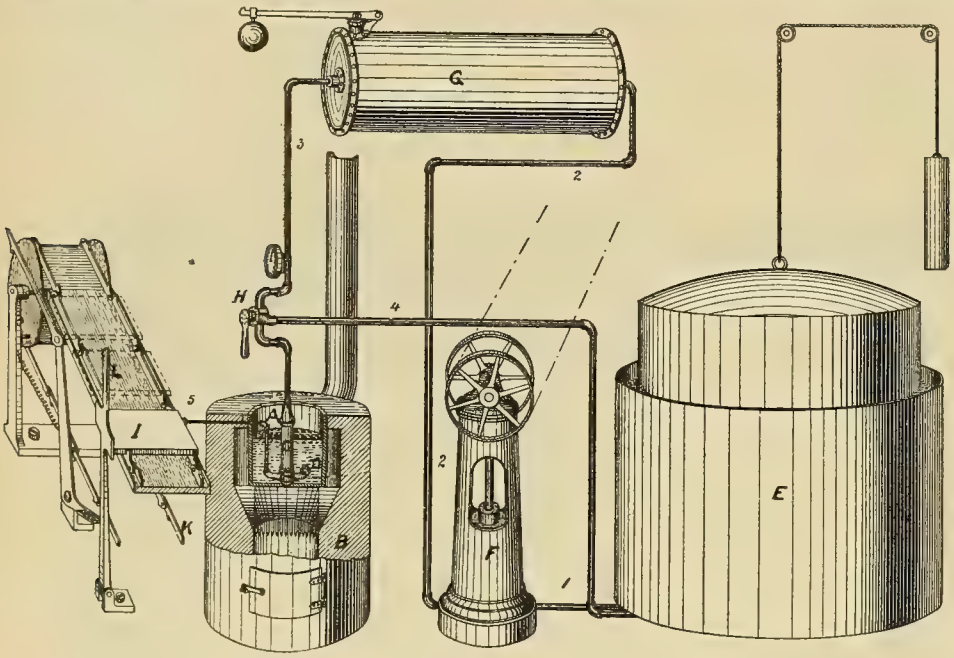


FIG. 1. PROCESS OF MANUFACTURING ACCUMULATOR GRIDS.

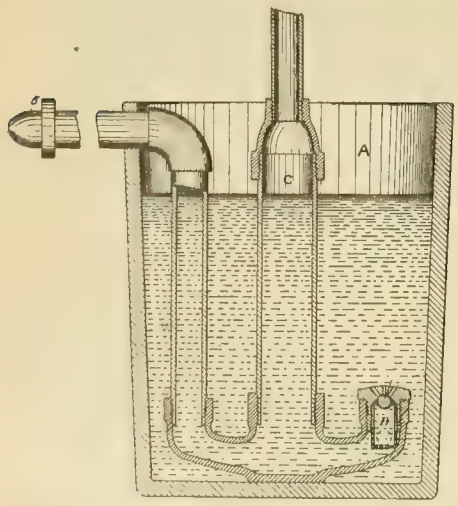
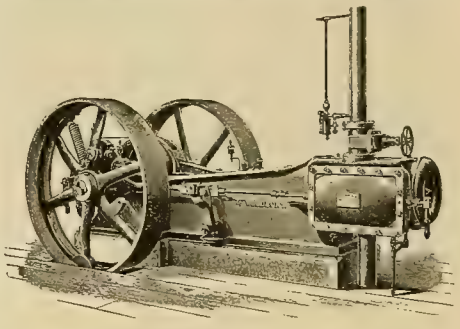


FIG. 2. PROCESS OF MANUFACTURING ACCUMULATOR GRIDS. THE CRUCIBLE.

The apparatus is operated as follows: The three-way cock *H* is turned so as to cut off cylinder *C* from holder *G*. The melted lead or alloy now passes into cylinder *C*, and at the same time gas is drawn from the gasometer *E*, and conducted by means of the force pump *F* under pressure into the holder *G*. A series of moulds or flasks, containing the cast plates, are placed upon the link belt *K* and caused to travel along the table by means of the foot lever, until the sprue of one of the moulds is opposite the nozzle 5. The sprue is forced into air-tight connection with the nozzle by means of the hand lever *L*, and the three-way cock *H* is then turned so that gas from the holder *G* forces the molten metal into the mould *I*. After a mould is filled the three-way cock is turned so as to cut off holder *G*, and the gas remaining in the cylinder *C* is permitted to escape into the atmosphere. A fresh charge of molten material is now allowed to refill the cylinder *C*. After one of the molds of the series is filled it is removed and another advanced by means of the link belt and the hand lever, and the above described operation is repeated indefinitely.



WOODBURY HIGH SPEED ENGINE.

Woodbury High Speed Engine.

In the accompanying cut is shown the latest form of the Woodbury automatic cut-off high speed engine. This engine was described in detail in the WESTERN ELECTRICIAN of July 2, 1887, but several improvements have been made since that time and the form has been materially changed. The illustration gives a view of the steam chest and valve side of the engine.

The cylinder and steam chest form one casting. The back head is covered by a polished cap, which also covers the nuts, and is easily kept clean. The front head is bolted between the cylinder and frame, the stuffing box being cast with the head. Both heads are made steam tight to the cylinder by ground joints.

The piston is hollow and as light as the requirements of strength will permit. It is in length equal to one-half the diameter of the cylinder, on all sizes, which furnishes ample wearing surface. The packing is simply narrow cast iron rings turned eccentrically and somewhat larger than the cylinder, and after they are cut, sprung into corresponding grooves in the piston head.

The governor is of the class in which the point of cut-off or valve closure is effected by moving the eccentric across the shaft, thereby varying the length of the valve travel. The movement of the eccentric is operated by centrifugal weights, the centripetal or opposing force being furnished by a single spiral spring. The peculiar features of the governor are its simplicity and small number of joints, the adjustment of the spring for sensitiveness, and that the direction of the pull of the spring is such as to bring the bearings upon the pivot pins always on the same side, whether the weights be moving outward or inward, thus avoiding all lost motion and rattling due to wear or loose fitting.

The frame was designed with the view of securing absolute rigidity and ability to meet without flexure or vibration the varying strains imposed by direct thrust and by the action of the moving parts. All the oil and drip on the inside runs down on the cross web of the frame to the crank end, and is there drawn off through a pipe. Cavities are provided for catching the oil from main boxes, eccentric and rocker arm. The space between the crank disks is covered by two shields, which prevent the throwing of oil from the connecting rod into the room. The inner shield is bolted to the frame and the outer one hinged at the bottom so that it can readily be thrown back when desired. Both shields are of cast iron, and are neat and ornamental in appearance.

The engine is the invention of Daniel A. Woodbury, of Rochester, N. Y., and is built by the Stearns Manufacturing company, Erie, Pa.

In Seattle, Wash., the people believe in electricity. Six electric railways are in operation and another is being built, and there are also three electric light plants, with a total capacity of 8,500 incandescent and 900 arc lamps. Every newspaper with one exception is printed by electric power. The presses in every job printing office are run by electricity, and electricity furnishes power for all sorts of factories.

Wind Pressure Gauge on the Eiffel Tower.

It has frequently been asserted that the erection of a structure like the Eiffel tower in Paris is of no practical value and that all that could

FIG. 1. WIND PRESSURE GAUGE ON THE EIFFEL TOWER

be derived from such an enterprise was the gratification of national pride or vanity. Students of natural science, however, for whom nothing is too small or too great if it can be utilized in developing theories and investigating the laws of nature, have eagerly grasped the opportunity which this mammoth tower affords for studying the variability of the atmosphere.

At the suggestion of M. Cailletet and with the co-operation of M. Eiffel, an air manometer has been constructed through the entire tower for the purpose of determining the pressure of the atmosphere at different heights. These measurements will have commercial value as a standard for the regulation and adjustment of metallic manometers.

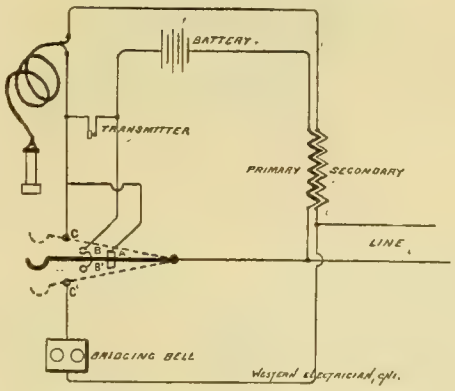
In the construction of the aerial manometer there is used a small steel tube or a series of tubes one-fourth inch in diameter, joined together with a junction box at every ten feet, and reaching from the ground to the summit of the tower. Each of the junction boxes has an outlet to which is connected a vertical glass tube, fastened on a wooden support with a polished front and furnished with a graduated scale. By means of the glass tubes the operator is enabled to make observations along the entire distance of the steel tube. Fig. 1 represents a part of the tower between the first and second platform, where the steel tube is run on an incline attached to the stairway, while the glass tubes extend vertically and are supported by the banisters. Fig. 2 represents the laboratory, which is located at the base of the west pillar of the tower. In the center of this room is a heavy iron reservoir containing mercury. A hydraulic pump, shown to the left, serves to compress water on top of the mercury through a pipe connected to the side of the reservoir. The pressure obtained when the mercury has ascended the tube to its summit is about 400 atmospheres or nearly 5,600 pounds per square inch. From the cover of this reservoir, which is securely bolted, extend three tubes, of which the one in the center carries the mercury to the tube in the tower, the second is directly connected to a large indicator on the wall, while the third is a regulator tube for the water pressure. The manometer indicator has a double graduation, one indicating the pressure in atmospheres and another at what junction box in the tower the mercury stands.

To make an observation of the atmospheric pressure at a given height, the operator's assistant ascends the tower to the desired height. By means of a portable telephone, which he connects to a wire running parallel with the tube, he puts himself in direct connection with the operator in the laboratory. While the latter operates the hydraulic pump driving the mercury into the tubes, the assistant in the tower opens the valve in the junction box where he is stationed, and watches the ascent of the mercury, which now will flow into the glass tube. When the desired height is reached, a tap on the telephone notifies the operator to stop pumping. Should it happen that the mercury has ascended too far, the operator in the laboratory opens the valve on the tube that regulates the water pressure, and lets on enough water to reduce the pressure as many degrees as his assistant in the tower has indicated to him by telephone.

To obtain an exact knowledge of the pressure of a column of mercury of a given height, it is necessary to know the average temperature of the mercury throughout the entire length of the tube, which often will vary several degrees from base to top. This is ingeniously determined, and with great accuracy, through the variation of the electrical resistance of the mercury, perceptible in the telephone, by means of a Wheatstone bridge. The manometer in the Eiffel tower has been in operation since April 2d. The cuts were reproduced from *L'Illustration.*

O'Connell's Method of Telephone Signaling.

One of the latest improvements which may be adopted by the Chicago Telephone company is the abolition of the magneto from the outfit of every subscriber connected with the exchange. It is proposed to operate the signal



O'CONNELL'S METHOD OF TELEPHONE SIGNALING.

drops on the exchange switch-board by an extra current from the secondary of the transmitter induction coil obtained by breaking or reversing the battery or primary coil circuit. In other words, the primary coil of the transmitter will be brought into action as a "spark coil," and the impulse of induced current in the secondary, which follows the breaking of the primary circuit, will be utilized to throw the shutter on the exchange switch-board.

This proposed modification of the present system of signaling with a magneto is the invention of Electrical Engineer J. J. O'Connell of the Chicago Telephone company. The diagram presented herewith gives a general idea of the manner in which connections will be made at the subscriber's end of a metallic circuit.

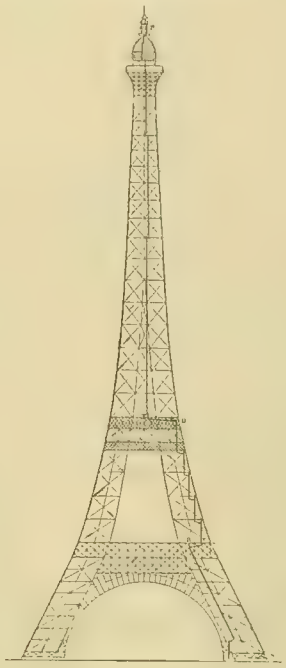


FIG. 3. WIND PRESSURE GAUGE ON THE EIFFEL TOWER.

In working the new arrangement the subscriber will merely remove the receiver from the hook and place it to his ear. The hook in flying up makes the necessary contacts, and the one impulse which is thus sent out over the line is sufficient to throw the shutter on the switch-board. The replacing of the telephone upon the hook sends out a second impulse of current which gives the "ring off" signal to the exchange operator.

In studying the connections laid down in the illustration the relative positions of the contacts passed over by the hook should be borne in mind. *A* indicates a metal strip in electrical contact with the side of the hook-lever. *B B'* and *C C'* are contact points. The length of strip *A* is such that it remains in contact with the lever only until it has passed up or down over either of the contacts marked *B* and *B'*. When the hook touches either *C* or *C'*, strip *A* is out of circuit.

A subscriber's outfit similar to the one described above is now in use in General Superintendent Wilson's office in the Chicago Telephone company's building. The new arrangement is said to work most satisfactorily.

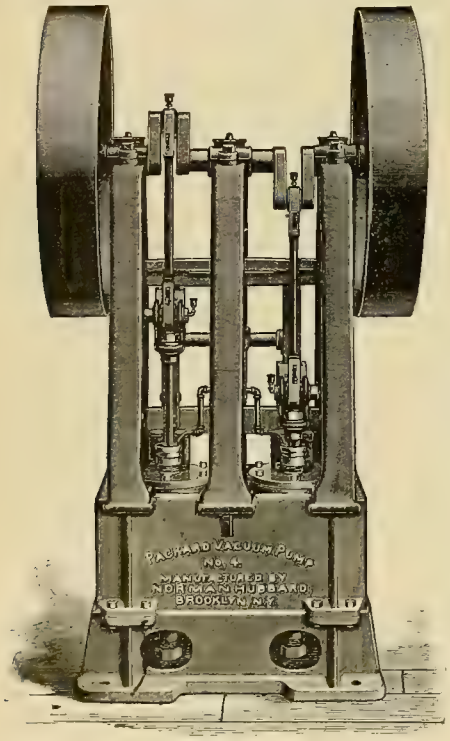
FIG. 2. WIND PRESSURE GAUGE ON THE EIFFEL TOWER.

The Carolina Light & Power company has received the contract to erect an electric light plant at Aiken, S. C.

The Packard Vacuum Pump.

The Packard vacuum pump shown in the accompanying illustration has been designed especially for use in the manufacture of incandescent lamps, to give the highest attainable vacuum, without the use of water in the cylinders, and to be capable of heavy, continuous work. The pump has been greatly improved since it was first introduced four years ago, and it has been adopted by incandescent lamp manufacturers generally in this country. There are now 126 of these pumps in use in incandescent lamp factories.

The cylinders are placed vertically in a cast iron box which serves as a bed plate and water jacket, and on which the frame and working parts are mounted. The frame is exceedingly rigid, insuring smooth and easy running. The parts are readily accessible, the bearing surfaces being of ample size and easily adjusted in case of wear. Each cylinder is entirely independent of the others, and can be used separately or connected up as required. The suction pipes are connected at the bottom of the jacket by means of ground unions, which are provided with traps to arrest any mercury or dirt, and the exhausts are piped to a pot which acts as a trap to catch the oil used in lubricating the



PACKARD VACUUM PUMP

cylinders, which is thus saved, and may be used over again.

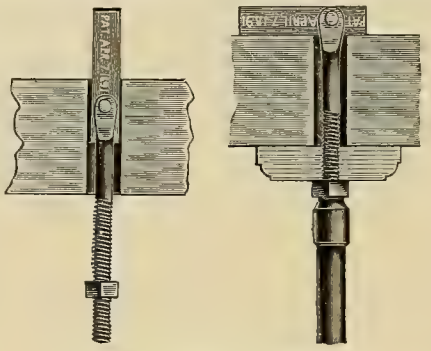
The valve motion is on the principle of the Ritchie valve gear, though greatly improved and simplified. All the valves are opened and closed automatically and do not require an air pressure below them to do this work. The main valve stem does not, as is usual with valves of this type, pass through the piston head. The piston packing is formed of hemp. The clearance in the cylinders is reduced to a minimum, being generally less than 1-16 of an inch, and no liquid is used other than sufficient oil to insure proper lubrication. The valves in the piston head have their seats close to the bottom, and are entirely inclosed in the body of the piston. The pump is manufactured by Norman Hubbard of Brooklyn, N. Y.

The Atlanta, Ga., Consolidated Street Railroad company has been chartered with a capital of $2,000,000. It proposes to operate its lines by the Thomson Houston system.

The Transcontinental Street Railway of Portland, Ore., has been purchased by the Willamette Bridge Railway company, which just closed a contract with the Thomson-Houston Electric company for twenty-five special street car equipments. The cars will be of the double truck pattern, made by the Pullman company. The Union Power company, recently organized in that city by leading capitalists, will furnish power for the operation of the Transcontinental and Multnomah street railways.

Wrigley's Toggle Bolt.

An ingenious device recently invented by Thomas Wrigley of Chicago is illustrated in the accompanying cuts. The invention consists of a toggle bolt and can be used to advantage in securing mouldings for electric wires, chandeliers and smaller electric fixtures to stone, brick, hollow tiling and marble slabs. It consists



FIGS. 1 and 2. WRIGLEY'S TOGGLE BOLT.

of a screw threaded shank with flattened pivotal cross bar, one end of which is longer and therefore heavier than the other. The application of the device is shown in the accompanying cuts. When the flattened cross-bar is projected through a hole made for the purpose in tiling or in the ceiling as shown in Fig. 1 the heavier end drops, thus securely fastening it in position as shown in Fig. 2. In Fig. 3 its application as a support for electric fixtures is shown. There is also shown a drill used for boring holes in tiling, stone, etc. Among the numerous applications of this device is that for fastening moulding supports for electric wires as shown in Fig. 4. These

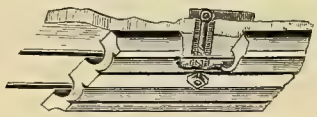


FIG. 4 WRIGLEY'S TOGGLE BOLT.

bolts may be made in any size desired. They are manufactured by Thomas Wrigley, Chicago.

The Telegraph and the Press.

Probably there is no other factor in the collection of news so valuable as the telegraph, and t ere is no other agency which has so greatly advanced the standing of the press as the telegraph. It has enabled enterp ising newspapers to perform feats that would have been pronounced impossible only a comparatively short time ago A notable instance of newspaper enterprise was shown by the St. Louis *Globe-Democrat* in securing a coveted prize. St. Louis is generally known among the western people as a city of slumber, but there are few journals in the country that can give the *Globe-Democrat* points on newspaper work. Here is the *Globe-Democrat's* story: "People who read in yesterday's *Globe-Democrat* Col. Robert G. Ingersoll's two column article on agnosticism had little idea of the amount of special effort and energy required to obtain it for our columns. The New York *Press*

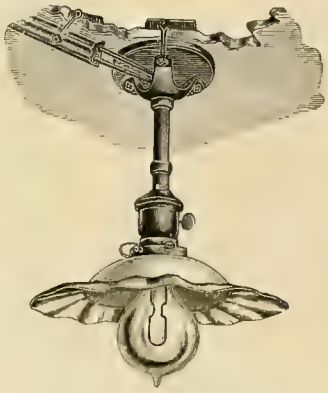


FIG. 3. WRIGLEY'S TOGGLE BOLT.

of Friday last, which reached the *Globe-Democrat* office at 9 P. M., contained an announcement that the Sunday *Press* would print an article on religion from the pen of Col. Ingersoll. The *Globe-Democrat* immediately telegraphed to the *Press*, asking its editor to send this article by telegraph to this paper, agreeing to give full credit to the *Press* and expecting to pay its share of the cost of the contribution. The *Press* answered politely, but firmly, in the negative. The *Globe-Democrat* then telegraphed to its correspondent in New York, instructing him to get an early copy of the *Press*, and if the Ingersoll article was not copyrighted to send it to us on as many direct wires as the Western Union could furnish. The New York papers are on the streets soon after 2 a. m., which is about 1 a. m. St. Louis time. It was about 1:15 a. m. in the *Globe-Democrat* office when the Ingersoll article began to come on four wires; and it was all on hand and most of it in type in one hour. We do not like Mr. Ingersoll's religion, but we have discovered that people like to read what he writes and says. We regret that the esteemed *Press* did not see fit to let us have the article, but we got it and gave the *Press* credit for it."

West End Street Railway Company, Boston.

The power house of the West End Street Railway company in Boston is one of the greatest generating stations in the country, and when completely equipped will probably be the largest electric street railway station in the country. Fig. 1 gives an excellent interior view of the power house showing the arrangement of the dynamos and engines. There are thirteen compound Reynolds-Corliss engines shown in the cut and each of these will drive four Thomson-Houston multipolar generators. The engines were built by the E. P. Allis Co., Milwaukee. In a recent statement before the Massachusetts legislature Henry M. Whitney, president of the road, said that this station would have over 13,000 horse power capacity before winter.

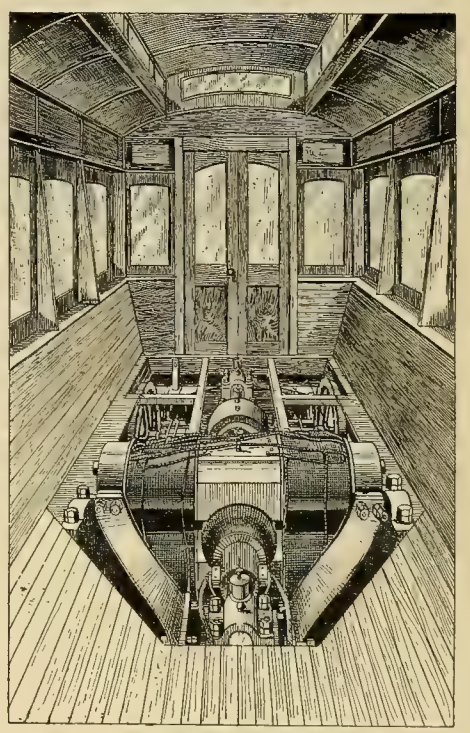


FIG. 3. WEST END STREET RAILWAY, BOSTON.

This equipment will be greatly enlarged during the next year, of course. At present the work is progressing favorably.

Reference to the cut will show clearly the plan of the station. Seven engines are arranged on one side of the house and six on the other. The driving pulleys of the engines are twenty-eight feet in diameter, having faces ten feet seven inches in width. Over these the power is transmitted by means of two belts each five feet in width, which lead over seven-foot pulleys upon the countershaft, having faces five feet two inches in width and running in pairs close together. Upon either side of the receiving pulleys are arranged pulleys ten feet in diameter having a thirty-two inch face, from each of which a thirty-inch belt transmits the power to the pulley upon the shaft of the generators, which are located upon the floor above. The generator pulleys are four feet eight inches in diameter and are to be run at 400 revolutions per minute. All the belts are provided with tighteners as shown in the illustration. Each section of the countershaft is connected by means of Hill clutches so that when they are all connected there will be two lines of countershaft, each 250 feet in length, the shaft being nine inches in diameter. It is the intention of the management to duplicate the entire plant as soon as possible after the present portion is in successful operation.

The West End company has been engaged

recently in experiment with motors and trucks, and several methods for arranging them.

Fig. 2 illustrates a motor and truck and shows the method of gearing the armature to the axle, all the parts being unusually heavy in order to

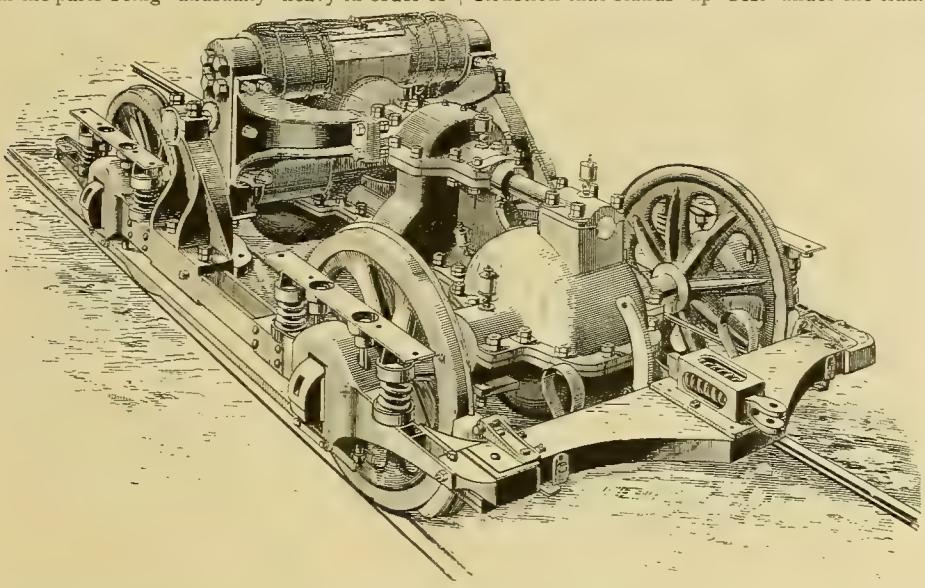


FIG. 2. WEST END STREET RAILWAY, BOSTON.

secure weight for traction and to insure durability. The weight is about twelve tons. The motor is of the Siemens type and is calculated to develop normally forty horse power, the armature making from 1,100 to 1,200 revolutions per minute. At a speed of twenty miles per hour the armature makes 1,500. The commutator has seventy-two segments.

Fig. 3 is an interior view of the car in which is shown the motor mounted well above the ordinary car floor, free from dust and dirt, and in position to give ready access to all its parts. The motor is mounted on the Bemis truck, with a six foot wheel base built expressly for this purpose. The armature and intermediate shafts are each three inches in diameter, and the intermediate is mounted beneath the armature shaft and parallel to it. All the bearings are from eight to nine inches long. The power is transmitted to the intermediate shaft by a spur pinion on the armature shaft, which in turn transmits the power to both car axles by bevel pinion and gear. The armature pinion is eleven inches in diameter and the reduction from

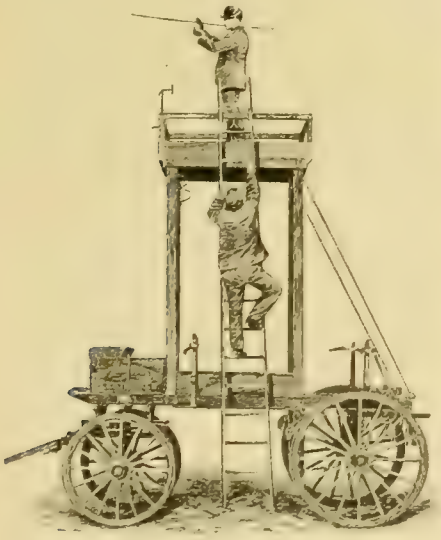


FIG. 6. WEST END STREET RAILWAY, BOSTON.

armature to intermediate shaft is one to two and from the intermediate shaft to car axle one to four.

Considerable attention has been given to improvements in line and track construction of late. A number of the new chairs devised by the Johnson company for use with the girder rail are being tried. This chair is reinforced underneath the rail with a flat plate through which the bolts which hold the two parts of the chair together pass. The T rail construction, which is used on the company's reservations, on some portions of the route, gives the best satisfaction, while on the other portions the construction that stands up best under the traffic and which the company intends to build largely during the present season is illustrated in Fig.

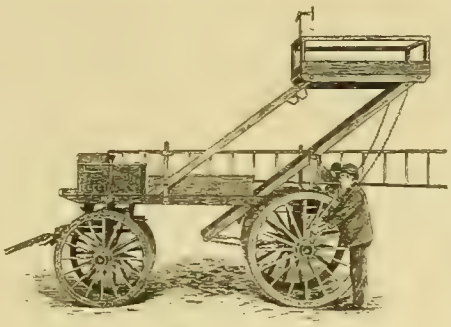


FIG. 5. WEST END STREET RAILWAY, BOSTON.

4, and consists in placing the girder rail upon a stringer foundation with ties after the old style horse railway construction with flat rail. Figs. 5 and 6 illustrate a new type of high wagon which is being used for construction and trolley repairs by the West End company. This wagon was designed by W. E. Baker of the Thomson-Houston company, and was built by W. S. Davis & Son of Concord, N. H. These wagons are made on a wide gauge so that they may stand astride the tracks and be readily turned out of the way of the car when necessary, and have an adjustable platform which may be raised or lowered by means of crank, chain and gear attachment as shown in Fig. 6. When moving from one place to another the platform and ladder may be entirely let down, when the wagon assumes the

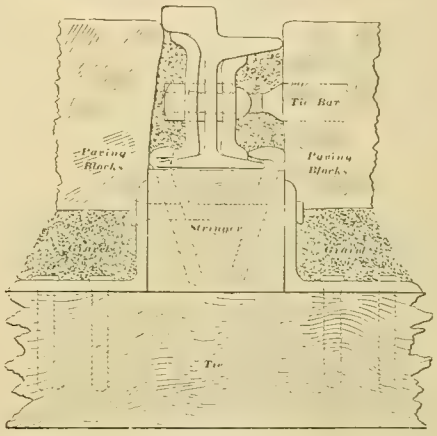


FIG. 4. WEST END STREET RAILWAY, BOSTON.

appearance of an ordinary vehicle. The driver's seat is in the form of a box which is utilized for storing the necessary tools. The cuts are reproduced from *Power-Steam* and the *Street Railway Journal.*

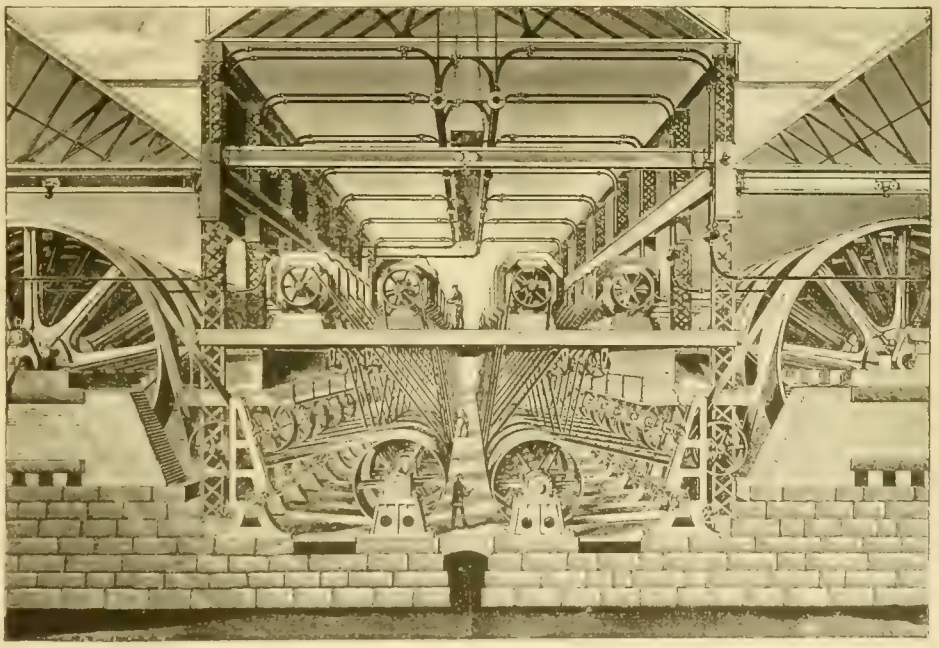


FIG. 1. WEST END STREET RAILWAY, BOSTON.

Chicago Electrical Association.

With the constant increase in the demand for young men in the electrical enterprises, there comes a desire on their part to enlarge their knowledge on electrical subjects. A number of the young men engaged in electrical houses in Chicago with this idea have organized the "Chicago Electrical Association." The object of the society is to afford a place for the young men of Chicago to meet and discuss electrical problems of the day. The organization was perfected last week by the election of the following named officers: J. F. Connor, president; F. R. McBirty, vice-president; E. G. Hovey, secretary; D. E. Webster, treasurer. The society starts out with a large and enthusiastic membership.

Construction work on the Belt Electric Railway in Los Angeles, Cal., is being pushed vigorously. The work now in progress involves a weekly expense of about $[illegible], and it is confidently hoped that the line will be completed within the specified time.

Western Electrician

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W. A. KREIDLER, - - - - - - - - - Editor and Publisher.
J. B. O'HARA, - - - - - - - - - - }
F. L. PERRY, - - - - - - - - - - - } Associate Editors.
W. E. KEILY, - - - - - - - - - - }

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.

W. H. TEMPLE, Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

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DURING the last week much of the attention of the Board of Directors of the World's Columbian Exposition, the National Commissioners and other officials was occupied by the representatives of the electrical industries. Two meetings were held, at which arguments were heard on the size, location and character of the building assigned the electrical department. The grounds and buildings committee of the Board of Directors first listened to the protests of the electrical people and then brought the matter before the Board of Control of the National Commissioners. These gentlemen listened to the arguments advanced by the electrical people and the explanation of the construction department. A full report of the proceedings of this meeting is presented in another column.

It is evident that the World's Fair authorities, or at least, many of them, realize that the protest of the electrical people is not without reason. President Palmer of the National Commission and President Baker of the Board of Directors were deeply interested in the discussion, and admitted the force of the arguments presented for a larger building and a united display. After the joint conference, however, nothing was done, and the announcement was made that the directors and commissioners had refused to interfere.

Instead of closing the discussion, this announcement merely served to increase the interest of the electrical people. The Board of Control of the National Commissioners passed an important resolution concerning the location of the power plant for the electrical machinery. Chief Burnham's plans provided for the location of the power plant 1,500 feet away from the electrical building. This would necessitate the conveying of 10,000-horse power of steam from the annex in the loop to the electrical building—a most costly experiment. The opponents of the proposed building urged a change in this particular. They convinced the commissioners that the plans should be changed, and the director-general was authorized at his suggestion to confer with the grounds and buildings committee and secure the desired alterations.

Throughout the controversy Director-General Davis has taken a sensible view of the matter. He has asserted that the building was too small and that the importance of the department demanded recognition. The claims presented by electrical people he believe were just and should be granted.

Before the directors Chief Burnham protested his willingness to make any change they deemed advisable. He said, however, that the plans for the electrical building could not be changed without disturbing the general effect. The other buildings would have to be changed and the work of the department seriously impeded.

This statement alarmed the directors, but Director-General Davis has since pointed out that, if necessary, a power house could be located within 300 feet of the electrical building without otherwise materially changing the present plans.

Another interesting point was the admission of Engineer Gottlieb that the electrical machinery will require 70 per cent. of the power used on the grounds. Nothing could better demonstrate the importance of the electrical exhibits. Within ten years this department has advanced to a position where 70 per cent. of the steam generated at the World's Fair will be used for operating electrical apparatus. Yet the construction department refuses this most important industry recognition in its demand for adequate space in which to make a creditable display!

If the directors of the World's Columbian Exposition and the National Commissioners sustain the construction department they will show themselves unequal to the work in hand, unable to grasp the importance of the subject and totally incompetent to conduct the affairs of the great exposition.

They have been warned repeatedly, and if they make a mistake, they alone will be to blame. The Chief of the Department of Electricity has warned them, the electrical people generally have signified their disappointment, and the director-general has declared his belief that the electrical department—the most important of the fair—will be a failure unless the demands of the electrical people for more space and a united exhibit are complied with.

As was expected, the Thiele bill to regulate telephone charges in Illinois met with defeat in the state legislature. The senators who voted against the proposed enactment are to be commended for their intelligence and good sense.

ACCOMPANYING this number of the WESTERN ELECTRICIAN is a double page supplement, similar to that given with the issue of April 25th, showing a fine perspective view of the proposed electrical building at the World's Fair. The drawing was made especially for the WESTERN ELECTRICIAN from the working plans, and the reproduction herewith presented is the first correct perspective illustration of the electrical building to be published. The southern and eastern sides of the building are shown, the former being the side that will front on the great quadrangle. A comprehensive description of the building, written by the architects, was given in the issue of April 25th, when the elevations and floor plan were presented. Taken together, the two supplements will give a complete idea of the appearance and arrangement of the building that will, as now seems probable, contain the greater part of the electrical exhibits at the World's Columbian Exposition of 1893.

AT the last meeting of the Chicago Electric club there was read a paper on "Substituting Electricity for Steam—From the Standpoint of the Steam Railroad Man," by Frank L. Perry. The paper is presented in another column. Mr. Perry argues that the problem of introducing electricity as a motive power on an extensive surface railway in place of the steam locomotive is an entirely different and a much more difficult one than that which exploiters of the electric street railway system had to solve. He has no desire to "belittle any of the noble work already accomplished;" but he thinks electricians will find it no easy task to convince the conservative railroad engineer that the station-along-the-route system, which is now admitted to be the most practicable one, is a better equipment than the present ideal independent power unit system. He refers to the station-along-the-route electric system as being "weak—most decidedly weak" in that it possesses the radical defect of its trains being dependent upon distant sources for their power.

There is no doubt a tendency toward electric locomotives rather than motors under each car. This is indicated even in the work that is being done in Boston, as a reference to the article presented in another column will show.

IT is gratifying to observe that the eastern electricians are heartily in accord with their western brethren in demanding that the electrical exhibit at the World's Fair be united rather than segregated, and provided with adequate facilities for a suitable display. Of course the eastern men have given the matter less attention than have the members of the fraternity residing in Chicago and vicinity, but Professor Barrett's eastern trip has demonstrated the fact that the electrical engineers and business men of New York and Boston are keenly alive to the importance of the exhibit, and the necessity of making adequate provision for it. The chief of the electrical department went East to consult the representatives of the leading companies, and he has sent back the most encouraging reports. On Tuesday last a telegram was received from him, dated at New York, in which he said that he had been greatly encouraged by the attitude of the eastern electricians, who had manifested warm and cordial interest in the affairs of his department. All with whom Chief Barrett had conversed were confident that the electrical exhibition at the World's Columbian Exposition should be the greatest display of the kind ever seen. General Davis was also heartily commended for the stand he has taken in upholding the rights of the electrical interests. Of course there could be no doubt of the existence of this sentiment throughout the fraternity in the East, but the instant and hearty expression of it at this juncture is none the less grateful and timely.

PROPOSED ELECTRICAL BUILDING AT THE WORLD'S FAIR, CHICAGO.

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Electrical Building at the World's Fair.

During the last week the electrical people have gained two important concessions from the World's Fair authorities, a change in the location of the power house, which brings the steam plant near the the electrical building and practically increases the size of the exhibit. This is a step in the right direction, and while the electrical people are to be congratulated, they should fully understand that there is still much to be done.

The representatives of the electrical interests appeared before the World's Fair officials at Chicago last week and made another formal demand for a larger building than that assigned them by the construction department, and presented their arguments for a united display. President Palmer of the National Commissioners, President Baker of the Board of Directors and the following named directors and commissioners were present: Messrs. Jeffrey, Saul, De Young, Schwab, Martindale, Lindsay, St. Clair and Lawrence. Director-General Davis, Chief of Construction Burnham, Engineer Gottlieb, Secretary Hornsby, Col. Clowry, F. B. Badt, C. A. Browne, F. W. Cushing, C. H. Wilson and W. A. Kreidler were also present.

Col. Clowry presented the communications from Chief Barrett of the Department of Electricity, and B. E. Sunny, chairman of the World's Fair committee of the Chicago Electric club, in which a formal protest was made against the proposed building. Secretary Hornsby of the Electrical Department made the opening address, by which he called attention to the necessity for having power in connection with the building by which it might be shown how much light or power is produced from a pound of coal. This, he said, was necessary to demonstrate the economic features of the plants on exhibition. Mr. Hornsby also recited the statements made by electric firms that a division of their exhibits would impair the effect of the display and discourage them from making the expenditures they deemed necessary for a grand display.

Chief of Construction Burnham had little to say beyond the declaration he has previously made that it was out of his power to make changes, and that building plans were already far advanced. Consulting Engineer Gottlieb supported Chief Burnham's position and said that there could be no rearrangement at this late day. He said that the only place for power was in the machinery annex, which is in the southwest corner of the park. Here, he said, the railroads could deliver the coal, and the smoke nuisance would be kept in this corner. If power were placed in the electrical building, coal would have to be transported over the grounds. He said 14,000 horse power would be provided and steam could be conveyed to other portions of the park where it might be needed. He said a 14,000 horse power plant would be the largest of which he had any knowledge.

Mr. Badt spoke against the divided exhibit and said some of the large Atlantic steamers used 18,000 horse power. He also said that steam could not be satisfactorily conveyed 1,500 feet, which is the distance between the machinery annex and the electrical building. C. A. Browne said it was absolutely necessary to have engines and power close to the electrical machinery.

Mr. Kreidler called the attention of the officials to the fact that when the Lake Front scheme was abandoned no additional space was granted the electrical people at Jackson park. He pointed out the necessity of a united exhibit and presented statistics showing the growth of the electrical industries. Special mention was made of the exhibition at Paris in 1881 which provided for more floor space for electrical display than the proposed building at Jackson park. Furthermore, the electrical exhibition at Frankfort this year will be more extensive than the building proposed by the construction department will allow the electrical people to make.

In the discussion over the requirements of the machinery and electrical departments the fact was developed that 70 per cent. of the steam power will be utilized by the electrical department. This significant fact shows the magnitude of the electrical interests. Despite the arguments presented, the committees refused to recommend any change.

During the discussion before the World's Fair officials last week Engineer Gottlieb explained the location of the buildings as at present proposed by the construction department. It appears from the present plans that it will be necessary to convey steam 1,500 feet from the power house to the electrical building. This will mean 70 per cent. of the steam generated. Mr. Gottlieb has further expressed his views on this subject in reply to a communication from the WESTERN ELECTRICIAN. He says he stated that with the modern means of protecting steam pipes it was possible to carry steam from inside the "loop" to the electrical building, "although there would be some condensation of steam, which would make it a little more expensive to the exposition company to furnish the power required."

It is held, on the other hand, that instead of costing "a little more," the expense of operation will be much greater, and the first cost of the plant greatly increased. Such a proposition will no doubt meet spirited opposition.

Director-General Davis, who has all along recognized the justice of the demand of the electrical fraternity for a larger building and an undivided exhibit, talked freely on the subject to a representative of the WESTERN ELECTRICIAN after the joint committee of commissioners and directors had made its decision.

"I have all along held," said he, 'that the buildings should be designed to accommodate the exhibits and the exhibits should not be required to fit the buildings. It is not to be presumed that an architect would possess a knowledge of the needs and dimensions of the various exhibits; the men interested in the industries represented would naturally be the best judges of that. It's all very well to talk about the general plan, the *tout ensemble* and all that, but the principal object of people visiting the exposition will be to see what is inside the buildings, and not to look at the structures themselves. What we want to do is to have exhibits that will attract the public."

"How about the power for the electrical building, General?"

"That is what I am working on now. In my opinion it is absurd to contend that steam power must be conveyed 1,5.0 feet from 'the loop' to the electrical building in order to obviate the necessity of smoke-stacks at the latter location. I do not believe that in a park of 600 acres the smoke from a power house for the electrical building would have such a very bad effect as is represented. I shall insist that suitable power be provided for the electrical display, as I am determined to do everything in my power to make the latter a success. One idea that has occurred to me in connection with this matter is to locate a power house on the wooded island in the lagoon north of the electricity building. This wooded island is to contain thirty-four acres, and is intended as a place where visitors can find 'rest and recreation.' That may be all right, but people won't go to the exposition to rest; they will go to look at the exhibits. At any rate, I think enough space could be spared on the island for a plant to furnish power to the electrical building. By this means the power house could be within 300 feet of the larger building. But whether this plan or some other is adopted, I shall certainly do all in my power to remedy the defect in the existing arrangements that the electrical people have pointed out."

"Does the decision of the committee finally settle the matter in favor of a divided exhibit?"

"Not at all. When it comes to locating exhibits the national commission is the authority that will decide. The construction department will have nothing whatever to do with it. For my part I am emphatically in favor of one grand united electrical exhibit. I think that the electrical people have just cause of complaint because the building at present proposed was not increased in size when the project for having a portion of their exhibit on the Lake Front was abandoned. The present design contemplates the same building as the one laid out when a considerable portion of the display was to have been held down town This is certainly unjust. But while it is perhaps too late to change the plans now, I shall firmly oppose the idea of having the exhibit divided among other departments. As far as the dimensions of the building will allow I believe that all the various applications of electricity should be shown. The allotment of space will have to be made carefully, and there should be as few repetitions as possible. There are six acres of floor space in the proposed building, and with judicious management this will contain a great deal. I have prepared a communication to the board of control giving my ideas on this subject of the division of exhibits, and I presume that it will soon be acted upon. It is possible that some way of adding to the building may yet be found. But in any event, the electrical interest can count on me to do my best to secure for it the magnificent and united display that it should have."

General Davis spoke with warmth and enthusiasm, and left no doubt in the mind of his auditor that the electrical fraternity would have his hearty support.

It is suggested by using oil instead of coal under the boiler of the power house for the electrical building the smoke annoyance would be obviated.

General Davis' communication to the board of control, alluded to above, was transmitted last Saturday morning. Following is the text of this letter:

Under the present contemplated arrangements for the construction of a building for the electrical department of the exposition, the chief of that department finds himself much hampered in his efforts to secure a creditable display for the World's Columbian Exposition of 1893, and unless some of the changes are made, as suggested by him, there is danger that the electrical exhibition will disappoint the expectations of the public, and of ourselves, who look to that department for one of the most attractive and instructive displays of the occasion.

I would respectfully request that the board take the necessary steps to secure for the department of electricity such changes in the present arrangements as will allow of steam power, including space and proper facilities for engine and boiler houses at, or immediately adjacent to the exhibit.

In requesting action in this matter, I desire to inform you of the grounds upon which it is urged. In order to secure the co-operation of the electrical fraternity it is manifestly necessary to present for exhibitors conditions that will give them the power to demonstrate the availability of electricity over steam or other energy. At this time in the history of the new industry the claim is made and insisted upon that electricity has the advantage of steam or other energy, in that it is more economical. As the burden of proof lies with the claimants, they deem it necessary to show that a given amount of power may be had by means of electricity at a cheaper rate in the matter of fuel than by any other means. To do this it is claimed that it is absolutely essential that exhibitors have their coal pile in the immediate vicinity of the electrical machinery, and that everything, from the fuel to the result, be so situated as to be capable of demonstration.

I may be allowed to say that the department of construction has proposed to supply steam power for this electrical exhibit by means of pipe transmission from the plant at the "machinery annex" building, some 1,500 feet away. It is believed that from a practical standpoint the idea of transmitting steam from that distance is impracticable, and should be avoided if possible, as the condensation in so great a distance would be so immense that the expense of maintaining the high pressure necessary would be prohibitive.

Electrical corporations are on the point of setting apart large sums of money for this exposition and are unanimously agreed that it shall eclipse anything of the kind ever before contemplated. In the direction of novelties and the unique apparatus so attractive to the public, many of these firms are already working. If this immediate power is made available for them, they will be enabled to so concentrate their exhibits that only the expense of one maintenance will suffice, and they will be, therefore, equipped to spend their money aggrandizing that which they are to combine their efforts upon. Moreover, if exhibitors are compelled to seek other departments to find the power to demonstrate the advantages of the machinery in which they are interested from a business standpoint, there will be really no inducement for them to spend money on the attractive features of such an exhibit, for the things they really care for are in other departments, while the attractions would be alone in the electrical building.

Whether this request of the electrical people is met or not, it is probable that the large corporations will have exhibits, but the display will be a failure, in that it will be a disappointment to the public and to the management of the exposition.

I trust that you will see your way to secure the integrity of this important department by finding this immediate power.

This communication was read at the meeting of the board of control by General Davis, who supported his position by a vigorous speech, in which he clearly pointed out the necessity of making adequate arrangements for supplying power to the electrical buildings. Considerable discussion ensued, with the result that the fol-

lowing resolution, offered by Judge Lindsay, was adopted:

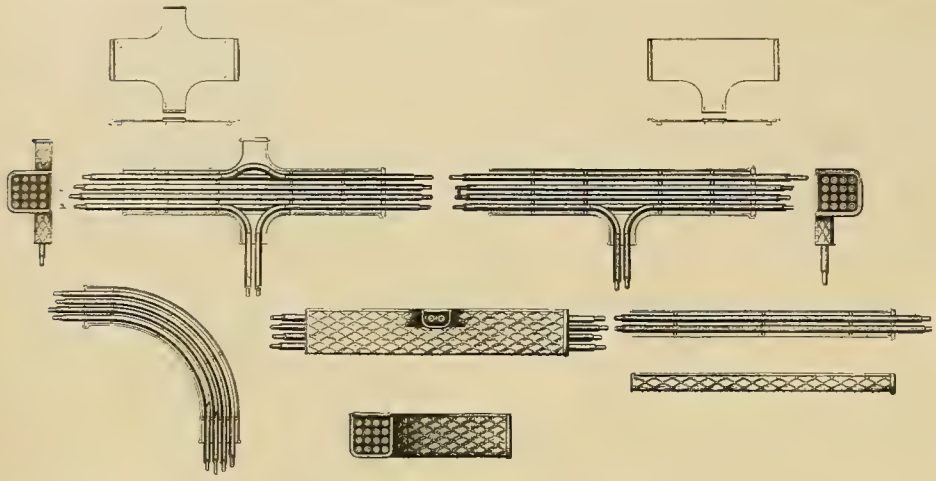
Resolved, That it is the sense and desire of this board that the steam power should be so distributed that so much thereof as may be necessary for the successful operation of the electrical display should be located in or immediately adjacent to the electrical building, and that the director-general be instructed and empowered to confer with the grounds and buildings committee of the directory of the World's Columbian Exposition, and ascertain by what means the aforesaid end may be accomplished, and to report the result of such efforts as he may make in this regard to this board at its regular meeting; and that attested copies of the communication of the director-general and of this resolution be delivered to the chairman of the said grounds and buildings committee.

This is exactly what the electrical interests have demanded in the way of power and this action is regarded as a great triumph for those who have the success of the electrical exhibit at heart.

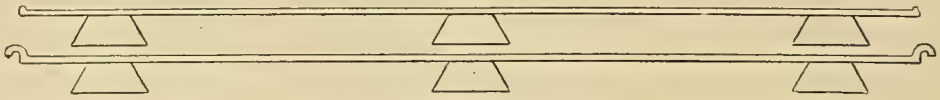
New Underground Conduit System.

In the accompanying cuts is illustrated the new underground system of the Interior Conduit & Insulation company, New York. The system is not unlike the interior conduit system, of which it is practically an outgrowth, as it consists of a series of highly insulating waterproof tubes for the reception of conductors. Bare copper conductors may be employed and an extension of the system or increase in capacity means only the withdrawal of the copper from the conduit and the substitution of larger conductors.

The conduit may consist of any desired number of individual tubes or ducts continuous from one manhole to another, no joints or couplings being employed. The method employed to convert the tube sections into continuous unbroken and unjointed ducts constitutes one of the important elements of the system. A light cast iron interlocking box is first laid in the trench and a series of telescopically formed tubes of any given number, length and diameter is then racked together within the iron boxing, so as to be held apart a uniform distance by insulating supports. The interstices between the individual tubes and the tubes and boxing are then filled in with an insulating compound, composed for the most part of coal tar pitch. This is poured in and it quickly solidifies, thus presenting a substantial body composed of a highly insulated material. The telescopically formed ducts constitute an important feature of the system. They consist of two tubes, one fitting within the other, the internal diameter of the smaller being that called for by the requirements of the use to which they are put. These tubes are made in 10 foot lengths, and, at the moment of laying, the inner tube is coated with an insulating compound or cement and then telescoped into the exterior tube to just one-half of its length.



NEW UNDERGROUND CONDUIT SYSTEM.



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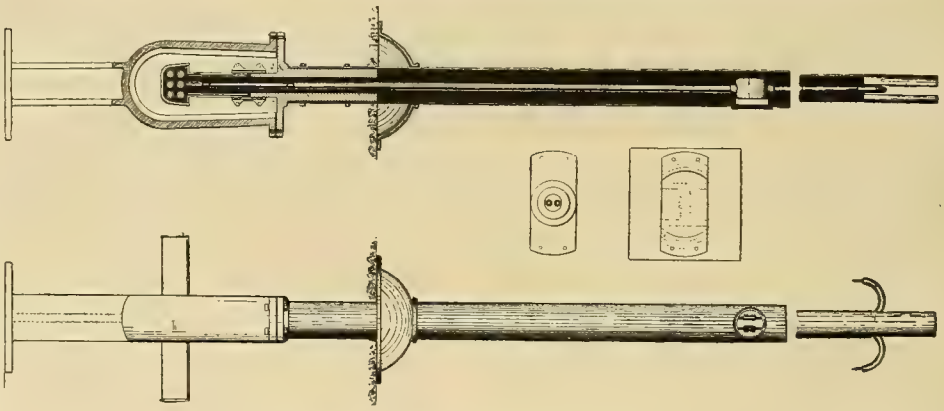

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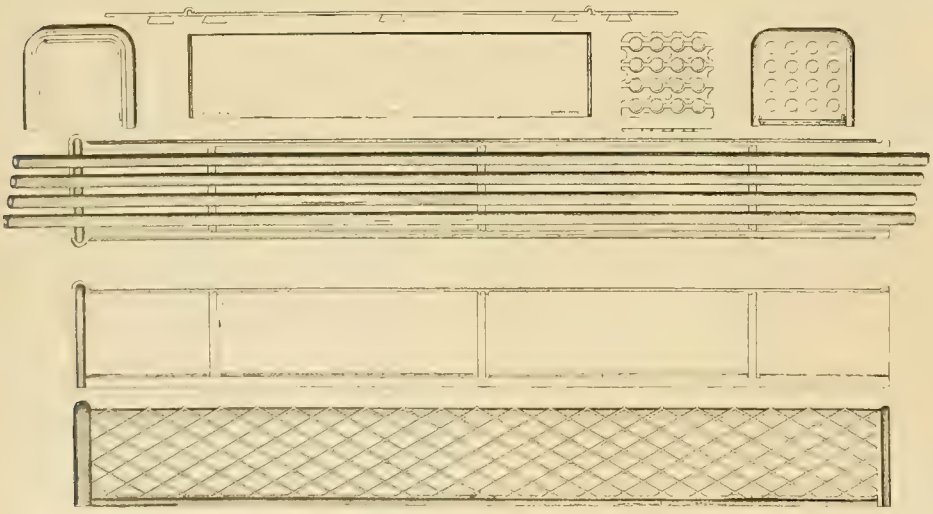


NEW UNDERGROUND CONDUIT SYSTEM.

The manhole is another important feature of the system. It is constructed of brick and preferably cemented to protect it, to a reasonable extent, from the exudations of the soil, for the sake of cleanliness. The section of the general containing box or conduit entering the manhole is expanded in a forked form and also in a vertical line, as shown in the accompanying drawings, for the purpose of separating and therefore providing greater space around the duct ends for more convenient manipulation.

The end of each section entering the manhole is provided with a cast iron head, on the face of which are short pipe projections, which are carried across the manholes to the opposite face plate by sectional iron pipes inclosing a section of the insulating tube. Those sectional pipes are adapted for easy and quick removal in order to render the conductors readily accessible. Lamp posts, feeder posts, elbows and other branch connections are provided, and are so constructed as to be minor extensions of the system. They are iron boxing or piping filled with insulating compound and joined to the conduit proper by suitably constructed elbow extensions, thus providing for the drawing in of the conductors from the nearest manhole to the top or extreme terminal of the post or other branch.

Annual and General Meeting of the American Institute of Electrical Engineers.

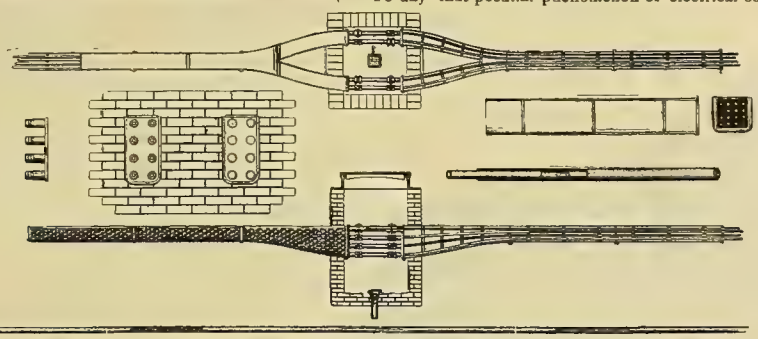
The spring meeting of the American Institute of Electrical Engineers will be held on May 19, 20 and 21, at its headquarters, 12 West Thirty-first street, New York City. The regular monthly meeting of the council will be held in the secretary's office at 5 P. M., May 19. The annual meeting for the presentation of reports, election of officers and other business, will follow at 8 P. M. on the same day.

The morning session of May 20 will be called to order at ten o'clock, when the following named papers will be read: "The Development of the Dynamo," by Prof. Harris J. Ryan; "Evolution of the Stationary Electric Motor," by Dr. S. S. Wheeler; "Some Data Concerning the Photometry of the Arc Lamp," by Prof. E. L. Nichols. In the afternoon the papers will be: "A New Graphical Method of Calculating Leads for Wiring," by Carl Hering; "Street Car Motor Design," by H. F. Parshall; "Some Recent Improvements in Printing Telegraphs," by Henry Van Hoevenbergh; "A Proposed Electrical Equipment for the Coming Rapid Transit System of New York City," by Frank J. Sprague. The evening session will be held at Columbia College. "Experiments with Alternating Currents of High Frequency" will be the subject for a paper by Nikola Tesla.

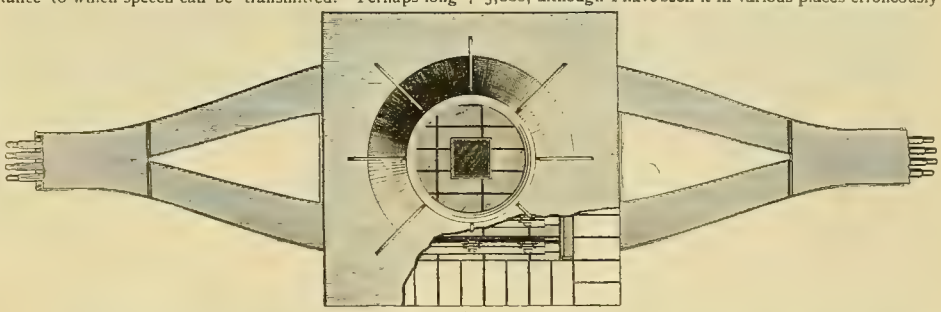
On Thursday morning, May 21, the members will meet at the Crocker-Wheeler Motor company's factory, 430 West Fourteenth street.

After an inspection of this establishment the meeting will reassemble at 12 West Thirty-first street, when the following named papers will be read: "A New Device for the Measurement of Alternating Current Potential," by Prof. G. S. Moler; "A Study of the Fluctuations of E. M. F. in the Open Coil Armature of a Constant Current Machine," by M. E. Thompson; "Some Results in the Practical Utilization of Electric Welding," by Dr. F. A. C. Perrine. At the afternoon session there will be "Electric Meters," by G. W. Walker; an address by Dr. W. H. Wahl on "The Aluminum Problem, Retrospective and Prospective," also a paper entitled "Shall Aluminum be Alium," by Oberlin Smith. In connection with this subject there will be an exhibit of aluminum products. On Thursday evening a reception will be tendered to the institute by the electric club.

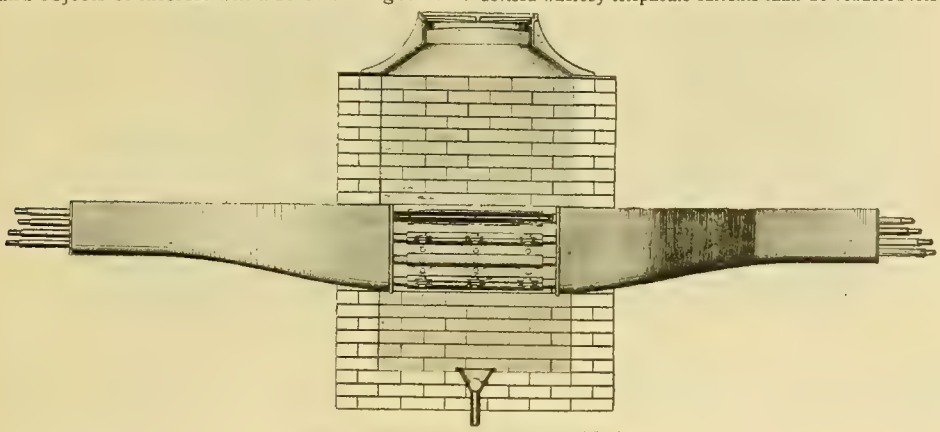
Visits to different electrical establishments and objects of interest will also be arranged for Friday, May 22, announcement of which will be published in the official programme.



NEW UNDERGROUND CONDUIT SYSTEM.



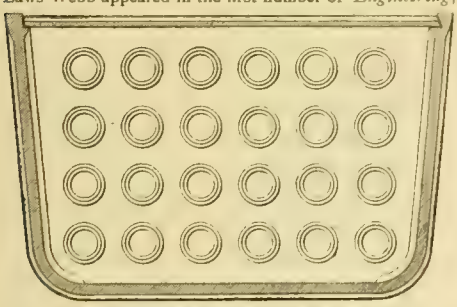
NEW UNDERGROUND CONDUIT SYSTEM.



NEW UNDERGROUND CONDUIT SYSTEM.

Possibilities of the Telephone.

The opening of the telephone service between Paris and London has given special interest to the topic of the possibilities of the telephone. Rapid development may be expected in this line. An interesting article by Herbert Laws Webb appeared in the first number of *Engineering*, in which he says: Telephony between countries separated by the sea is already an accomplished fact. Twenty years ago the prophet who would have ventured such a possibility would have been laughed to scorn. Who would venture to assert to-day that fifty years hence telephony between the New World and the Old will not have been accomplished, and that "a chat with Europe by telephone" will not become an every day matter for those who shall be able to afford such a luxury?



NEW UNDERGROUND CONDUIT SYSTEM.

True it is that by the light of our present knowledge it seems scarcely possible to hope for such a revolution in the world's methods of communication; but if the present rate of progress be maintained, if new discoveries arise as frequently in the future as they have in the near past, what seems impossible to-day may be a step nearer to morrow, and each step diminishes the apparently illimitable distance. He would be a rash prophet who would set a limit on the possibilities of electricity.

To-day that peculiar phenomenon of electrical conductors called "static retardation" imposes a limit on the distance to which speech can be transmitted. Perhaps long ere fifty years have rolled by some means will have been devised whereby telephonic currents shall be rendered less susceptible to the deadening influences of retardation, and the range of long-distance telephony will consequently be enormously increased.

The telephonic current is the smallest one (in the sense of developing a comparatively microscopical amount of energy) which can be made to do any useful work; and it can be easily understood that in order to transmit this feeble, undulating current over five hundred miles of wire and turn it to account at the other end, the highest pitch of excellence must be maintained in line and instrument construction. The range of the telephone has been greatly increased during the past five or six years, and it is as easy now to talk from New York to Boston or Buffalo as from the City Hall to the Battery. But the limit of distance at which long-distance telephony can be commercially successful is fast being approached, if it has not already been reached.

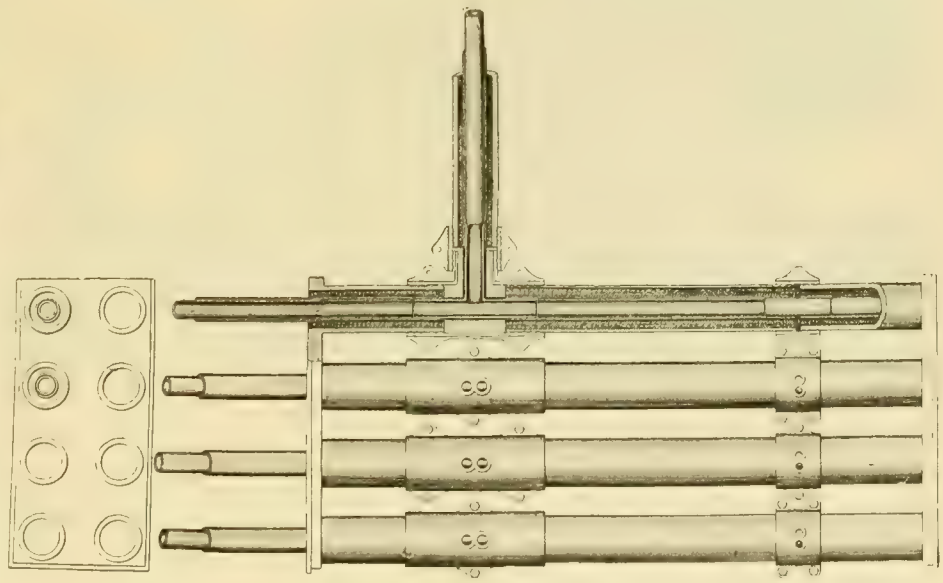
To establish a submarine telephone line 100 miles long it would be necessary to lay two cables, as the use of metallic circuit is absolutely necessary, and the line would have to earn about five dollars a minute to be commercially successful.

There are two long distance telephone lines at present working in which submarine cables of some length are employed. The first of these is the line completed about eighteen months ago between Montevideo and Buenos Ayres. Its total length is about 180 miles, of which 23 miles are of submarine cable laid across the mouth of the River Platte The overhead line is built of extraordinarily heavy wire weighing about 850 lbs. to the mile, the resistance being less than one ohm to the mile. The line is metallic circuit throughout and there are two cables laid side by side across the river. The speaking is said to be excellent, which is not at all surprising, as the K R is less than 5,000, although I have seen it in various places erroneously stated as being 10,400. With such a wide margin, it is evident that the constructors of the line might have saved themselves a lot of money by using a lighter wire. The second submarine telephone line is that recently opened between London and Paris, which enjoys the distinction of being the first international telephone line established between two countries separated by the sea. The distance between the two capitals is about 275 miles, of which 254 miles is made up by the land lines, 74 miles on the British and 180 on the French, the cable across the British Channel being 21 miles long.

No telephone engineer can feel ashamed of the progress that has been made in telephony during its short history as one of the commercial applications of electricity, but many onward steps, however, are needed; many improvements and many new discoveries before we can see our way clearly to the establishment of telephonic communication between the New World and the Old.

A Well Deserved Promotion.

J. J. O'Connell, foreman of the electrical department of the Chicago Telephone company, has recently been appointed to the position of electrical engineer for the company. Mr. O'Connell's promotion is a well merited compliment to his ability. As an inventor of telephonic apparatus he takes a place in the front rank. A large number of the ingenious devices now being operated and constructed by the Chicago Telephone company were designed by him, and the Patent Office records show that his knowledge of the needs of the telephone service is most comprehensive. The management of the Chicago Telephone company will doubtless find that it has made no mistake in showing an appreciation of the services of a valuable man



NEW UNDERGROUND CONDUIT SYSTEM.

Water Power and Electricity.

There is no problem in which electrical engineers are so deeply interested to-day as that of transmission of power. The immense water powers of this country may be utilized and transmitted by electricity, whereas they might otherwise have continued to be wasted. In the solution of this problem it was found necessary to devise special machinery and appliances. That this has been done is shown by the fact that there are many electric stations in this country to-day operating by water power. The accompanying cuts illustrate several specially designed turbines manufactured by the Stilwell & Bierce manufacturing company of Dayton, Ohio, for the Spokane, Wash., Edison Electric Illuminating company.

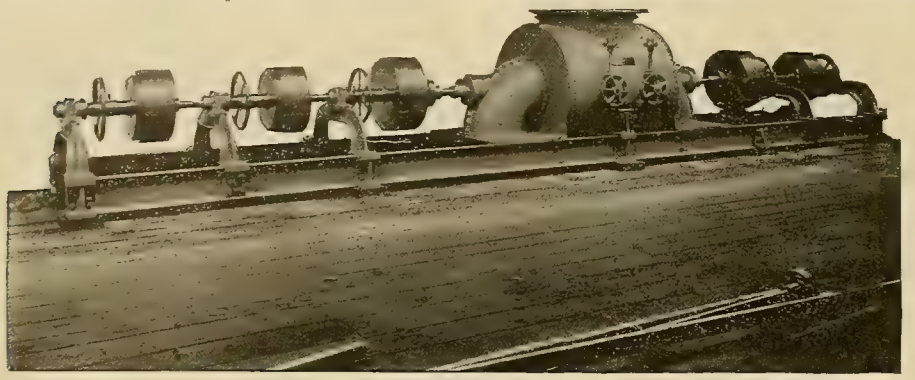


FIG. 3. WATER POWER AND ELECTRICITY.

Fig. 1 represents six pairs of Victor turbines on horizontal shafts, each pair designed to drive two dynamos direct from the turbine shaft, and operating under 70 feet head. These turbines are all supplied with water from one horizontal feeder, a branch feeder extending to each pair of turbines, provided with a valve gate for shutting out the water. Each turbine of each pair is entirely independent having its own governor and gate rig, so that either one or all may be operated at will. A pair of horizontal Victor turbines of peculiar design is shown in Fig. 2. The turbines are seated upon and discharge into a cast iron draft box, the whole placed within a wrought iron flume (the upper part of which is removed to show the turbines), having an end connection with the feeder leading to the canal. Seven pairs of this design were furnished the Sebago Wood Board company. In Fig. 3 is presented a view of a pair of fifteen inch Victor turbines on horizontal shafts, equipped with improved disk friction pulleys for driving dynamos direct from the water wheel shaft. The entire arrangement is simple, compact and strong.

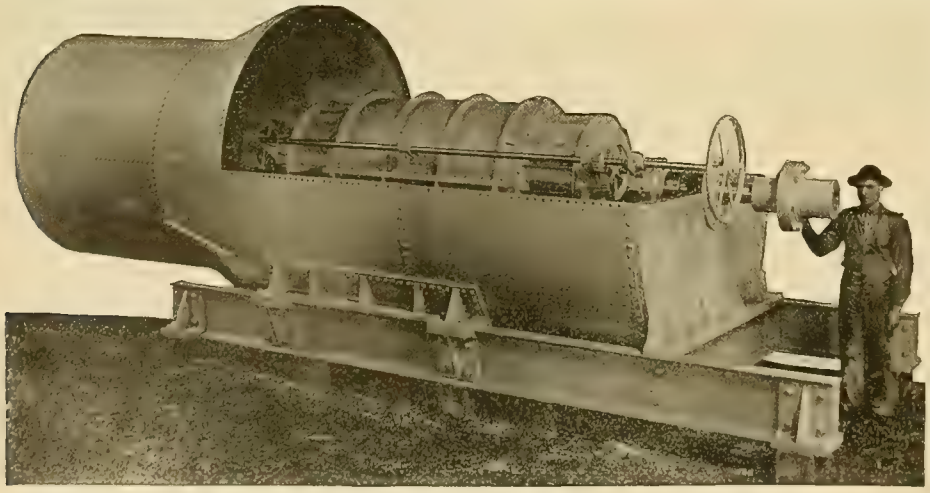


FIG. 2. WATER POWER AND ELECTRICITY.

The western extension of the North avenue electric railway of Baltimore, Md., is now in operation. The extension just opened is about a mile in length, and runs from Highland Park through Walbrook. The North Avenue company now has three passenger cars running upon the road, equipped with Sprague, Baxter and Wenstrom motors, respectively. A fourth car is expected this week, which is equipped with a slow speed Westinghouse motor.

Substituting Electricity for Steam—From the Standpoint of the Steam Railroad Man.[1]

By Frank L. Perry.

We all remember the old saying to the effect that there are two sides to every question, and it is with the object of presenting another view of a most interesting problem that the writer has ventured to-night to drop the now almost proverbial enthusiasm of the electrician and take a position which may, perhaps, be referred to as one which only a pessimist or croaker would assume. It is a noticeable fact that in this electrical era the world in general and electrical men in particular are prone to indulge the fancy with what might be called Utopian dreams as to future developments of electrical machinery. Predictions emanating from the fertile brain of the imaginer are often found to be most delightful reading, and in some cases they may be deemed of great value in that the inventor finds them to be suggestive. But as things appear to the dreamer just as he would like best to have them, a too great indulgence of the fancy, especially in the case of the electrical engineer, is apt to lead to degeneration. For this reason there arises the tendency to imitate the ostrich of the story, and bury the head in the sand, with the hope that we may in some way avoid obstacles and difficulties without looking them squarely in the face. Let us, then, in our consideration of the problem now at hand, look over the situation as it actually appears at the present time, with the object of seeing and not hiding from any difficulties which may exist.

[1] Read before the Chicago Electric Club, May 1, 1891.

During the last two or three years there have appeared a number of very valuable papers treating of the subject now before us, viz.: The substitution of electricity for steam on extended surface railway lines. The most prominent of our electrical engineers have attacked this fascinating problem. Some are sanguine enough to predict that in the near future the electric motor as a train mover will supersede the steam locomotive; but the more conservative content themselves with expressing a belief that as far as the mere *operation* of a road is concerned the electric system could be developed to that point where it would rival the steam equipment and, possibly, displace it. As a result of these conclusions there has arisen considerable discussion as to the more important details of a large and extended system. From data obtained through experience with successful American electric street railway systems, our best informed electrical engineers have been enabled to map out what they expect will be the railway of the future. It is generally conceded that the station-along-the route system is the one which seems the most feasible and, in the light of our present experience, the most practicable. By the "station-along-the-route system" is meant an electrical equipment in which a number of generating plants would be located at intervals along the line of the road, from which currents would be fed out to a working conductor laid parallel with the track.

If, then, it is admitted that such a system as the one referred to is the best which can be offered, there can now be brought up this all-important and pertinent question: How may we look for the change to be effected on roads already equipped with steam locomotives? Assuming that the usual schedule of the steam road could be maintained with the electric system, let us study evident conditions in the problem, and endeavor to ascertain just what are the prospects of the station-along the-route system meeting with favor in the eyes of the plain, everyday railroad man. By the expression "plain, everyday railroad man" I mean one of a class of engineers who know of electricity mainly through hearsay, but who, from an extended experience with the locomotive and other rolling stock, have attained a thorough knowledge as to what character of machinery is required to make a reliable and efficient service.

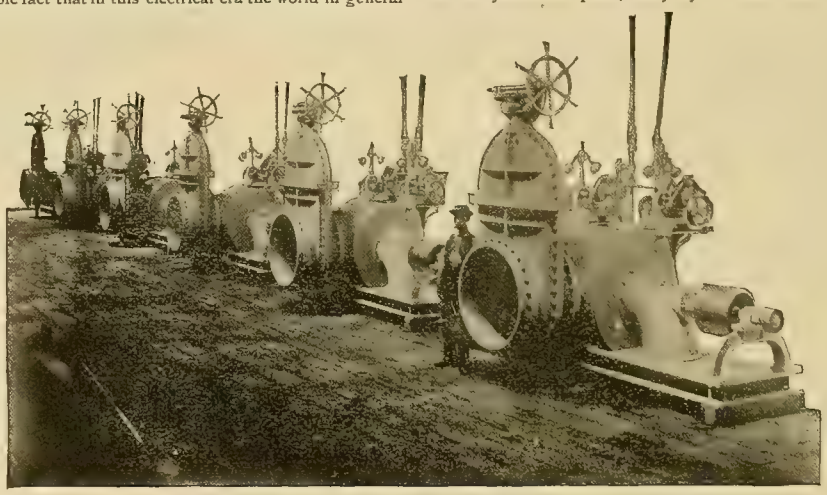


FIG. 1. WATER POWER AND ELECTRICITY.

As a class railroad men are conservative to a degree, and in many instances this peculiarity of character prevails to such an extent that it might almost be called conceit. A member of this club once remarked, in speaking of his treatment by a railroad official, "They know it all." This is slang but it best expressed his feelings after a futile attempt to convince the official that a change in the size of a steam pipe was necessary to insure the satisfactory performance of a railway lighting plant.

Now it is this class of engineers that must be approached and convinced before the wedge, so to speak, can even be entered. Let us, therefore, without prejudice, study a few of the more important features of the system which some think will be usurped by the station-along-the-route electric equipment. But before we begin to make a comparison of the relative advantages offered by steam and electricity let us consider for a moment what had to be accomplished in exploiting the electric motor in competition with animal power. The question of competition with the cable system can be left out of the discussion, as the latter system's field of usefulness is limited to street and tramway service; besides it was through the electric motor that the emancipation of the horse was accomplished.

The successful introduction of electrical motive power upon a large proportion of American street railways and the rapid advance made in perfecting the electric apparatus are accomplishments often referred to as being phenomenal—and so they were. But as wonderful as we may deem these results I feel sure we will have to admit, eventually, that the displacement of the horse and mule was, compared with the work now under discussion, an easy achievement.

The electric motor entered the street railway field against a machine—if I may so designate our equine friend—which can be pronounced most expensive in its working when the service obtained is taken into consideration. The horse railway might, I think, be aptly compared to the old-time mill engine, which, it is said, consumed almost as much steam when driving the fly wheel as when running under load. In other words, horses had to be fed whether at work or idle, and corn, oats and hay come high. When we think of changing teams four times per day, and also figure upon the expenses incident to the maintenance of

the immense barns necessary for the proper housing and care of this living apparatus—not to forget, in our calculation, the interest on the real estate investment—it is not difficult to see that the salesman of the electric company had, to say the least, a few good points with which to start his argument in favor of the electric system. The proposal to do away with the huge barns and their inefficient and dirt making occupants, and to substitute not only an efficient system but one which consists in its entirety of a small station, an overhead wire with, perhaps, a few feeders, and the fitting up of each car with a motor, was to the street car man most reasonable and attractive The steam railroad man would consider a similar proposition to substitute substantially the same system for the locomotive on an extended line, from an entirely different standpoint.

On the American steam road we find a system already ideal to the extent of its operation with independent units of power. Each train goes out equipped, if it may be so expressed, with its own complete power station, fuel, generator, motor—all in one. To compete with this independent unit system it is proposed to install an equipment which is virtually a steam driven one, and in the operation of which trains will be entirely dependent upon one, or at best two, sources of power located many miles away. In this point particularly I think the station along-the-route system is weak—most decidedly weak. I would ask the members of this club if it is likely that the management of any extensive steam surface railway would ever abandon the locomotive to give place to what might be called an improved steam system on which a train could be brought, by maliciously disposed persons from full speed to a standstill without loss of life and but slight damage to the system? Think of the ease with which the short circuiting of a train within a block could be brought about! I do not mean to say that a rival of an electrically driven road would resort to such means to demonstrate the superiority of steam and thus secure the bulk of the traffic, but I do mean to say that a railroad company will hesitate before it gives the other road the chance.

There are other disadvantages in the station-along the-route electric equipment which must also be demonstrated to have no weight before, I fear, the railroad man will come over to the electric system. Advocates of the above-mentioned system find themselves also confronted with a number of difficulties of a mechanical nature.

The question is raised as to the tractive power of the electric locomotive. It is hardly to be supposed that electric motors would, at the start, be generally applied to the axles of the cars on a steam surface road. There is a tendency even at the present time in the direction of an equipment with electric locomotives, or the use of the motor car to pull a train of trailers.

If such then is to be the practice—and it seems reasonable to suppose that it will—must not the relative lightness of an electric locomotive as compared with the steam locomotive be taken into consideration? Much has been written and said concerning an increased tractive power caused by the passage of the current between the car wheel and rail. Experiments have been made which, it is claimed, establish this as a fact. More recent tests, however, disprove the idea. Even admitting that there is an increase in tractive effect, one can but question whether this increased adhesion can be made to compensate for the weight of—to make it the least—a huge boiler and furnace. One glance at the steam locomotive slipping its wheels while getting under way on a track well sanded is sufficient to bring us to a realization of what would be the importance of weight in the electric locomotive.

It is, perhaps, unnecessary also to point out that on an extensive system the motors will necessarily be operated with currents at a high pressure but of small quantity, and for this reason our electrical tractive effect would be lessened. Besides this, who can say that, all things considered, the conditions may not be such that the rail-return will prove an unsatisfactory element in a system extending over many miles? To be sure if we allow that the tractive effect can be materially increased by the passage of current an auxiliary dynamo worked in connection with the locomotive might be employed, but even with this apparatus, can we not bring up the question as to what will be the effect in the long run of the continuous passage of a current of large volume between the wheel and rail?

In answering the question as to the relative lightness of an electric locomotive it will, doubtless, be proposed that motors be applied to each car of the train. This reply I answer with another question: Does it seem reasonable to suppose that a steam surface road could be found which would permit alterations in its entire rolling stock?

No, I think if we come in it will be first with the electric locomotive, and we will have trailers in the shape of the ordinary passenger coaches and freight cars. Perhaps—I will now venture a conjecture—the-station-along-the-route electrical equipment may after all be that of the future. But perhaps the storage battery will be brought into aid us in overcoming the inherent difficulties in the station-along-the-route system. Who would be willing to put himself on record with the statement that we would never make a 200 mile trip behind an electric locomotive weighted down with a battery of accumulators, and taking current from a conductor supplied from a station miles away?

In conclusion I would impress upon the members of this club that I look for the greatest progress in the application of electricity to general railway work. The electric system has distanced its competitors in the street railway field, and the electrical companies now naturally sigh for 'other worlds to conquer.' As I have pointed out, their eyes are turned upon the more extensive systems. Already enough has been accomplished to convince us that in the very near future, a steam locomotive on an elevated road will be a thing of the past. Undoubtedly, though, before we commence upon the long surface lines our knowledge will have to be increased by much experience. The discussion of the problem has only begun, and the more we think and talk, the more will be our insight into the difficulties and the better fitted we will be to furnish remedies. In preparing this paper it was not my desire to belittle any of the noble work already accomplished. I wished to look ahead, not behind, and I can only hope that my paper will excite further discussion on this subject.

Electricity in the Production of Aluminum.[1]

By Alexander S. Brown.

PART II.

At the Rhine Falls, at Froges and at Boonton these machines are coupled directly to turbine wheels arranged upon horizontal shafts. The frame to which the field magnets are attached is a solid casting, weighing alone over nine tons. The field magnets are excited by a smaller dynamo driven by belting from a pulley on the main shaft. This smaller machine was also designed by C. E L. Brown, the armature being similar to that of the large machine, except that it has but one commutator. This exciting machine is run at 60 volts and 120 amperes, and its performance is worthy of all praise.

At Boonton the bus wires are eight in number, four positive and four negative, each wire being square and having a cross section of one inch. They are, in fact, rolled copper bars, uninsulated, because the low potential of the current requires no special insulation. An ammeter is placed in the main circuit by a simple arrangement, for the guidance of the workman who specially looks after the crucible. The distance from the dynamo to the furnace, which is situated in another room, is only fourteen feet. The four positive wires pass directly to the clutch which holds the anode, and the four negative wires pass from the ammeter back to the dynamo.

The crucible together with the method now in use for raising and lowering the anode, is composed of a strong iron box, which has a deep lining of carbon, previously ground very fine, mixed with sufficient tar and thoroughly compacted on the bottom and around the sides of the containing iron box. After the furnace is thus relined, the carbon is baked in order to drive away the tar and harden the lining. You will see that the position of this crucible is directly the reverse of those used by the Cowles company and that the carbon crucible itself actually forms part of the electric circuit. Unlike the Cowles process Heroult's is a continuous process, the reduced metal being tapped from the bottom of the crucible while the machine is merely stopped or slowed down for a few minutes. The interior dimensions of the crucible vary with the ore to be reduced, and the size and character of the anode used. Ordinarily it has an interior depth of about 22 inches and a clear space of 6 inches between the walls and exterior surface of the anode. The electric current passes into the crucible through the suspended carbon anode, the vertical position of which is controlled by an attendant who lowers it from time to time to preserve an approximately constant distance between the bottom of the anode and the surface of the molten bath in the crucible. The anode usually dips several inches into this molten bath and in practice the intervening space between its bottom and the surface of the molten metal is kept at about an inch by the attendant, who by touching the needle of the ammeter is enabled to maintain the electrode in its proper relative position without difficulty. In order to get as perfect a contact as possible between the furnace and the cables leading therefrom back to the dynamo, the cables are firmly clamped to a large block of zinc, which projects from the rear of the furnace and is kept cool by water circulating in pipes around which the zinc is cast. While, properly speaking, the crucible has no top, as a rule plates of carbon embedded in dry alumina spread over the top of the crucible, are so adjusted as to fit close to the anode in order to retain most of the heat. The mouth of the crucible is formed of slabs of carbon built up funnel shape. The hearth or floor is pierced by a tap hole, which is kept closed by a plug of carbon or fire clay, and is opened from time to time to allow the molten metal to run into a carbon lined ladle, from which it is cast into ingots.

There are a few distinctive but not important differences between Heroult's method of making alloys and reducing pure metals simply. In making alloys, the base alloying metal is first melted in the crucible by the current, or molten metal is poured into the furnace to form a liquid metallic cathode. This is usually, simply and economically accomplished by throwing pieces of the metal—copper for instance—into the furnace, seating the anode upon them and passing the current At first the current is very unsteady, arcs are constantly forming between the copper and the anode, but when the copper is entirely melted (and it takes but a very few minutes to melt 200 or 300 pounds) the ore to be reduced is added in sufficient quantities to form a bath, and floats on top of the molten copper. The anode having been raised so as to leave a space of about an inch between its bottom and the molten copper, the current becomes steady, and the operation is established. Thereafter the ore is introduced in small quantities, at frequent and regular intervals, until the desired percentages of aluminum or silicon contained in the alloy have been secured. This percentage can be regulated entirely at will up to about seventy per cent. of reduced metal. No external heat is used, and the process is absolutely continuous at the will of the operatives, which are special features of the Heroult system. The passage of the electric current through the bath serves not only to keep the copper in a fluid state and to melt the ore, but also electrolyzes and decomposes the latter. It is a point of careful regulation in the Heroult processes to maintain only sufficient heat to keep the bath fluid, since any further expenditure is not only useless but lessens the output. The oxygen from the reduced metal combining with the carbon of which the anode is composed is burnt with the production of carbon oxide gas, which escapes from the crucible around the sides of the anode and at the feed hole. The product is withdrawn at intervals by tapping the bottom of the crucible as in ordinary smelting. Each time the metal is tapped, a sample is carefully preserved for accurate analysis, to determine the percentage of contained aluminum.

From a metallurgical point of view the amount of labor required to operate this process is astonishingly small. The metal produced in the Heroult furnace is sold generally in ingot form, just as it is tapped, without re-melting or being subjected to any purifying manipulation. It is always, however, very pure, sometimes dropping as low as ninety-eight and one-half, but generally running over ninety-nine per cent. of absolute purity. This is largely due to the great care exercised in selecting raw materials. In making bronzes, the best Lake Superior copper is used, while the oxide from which the aluminum is reduced is an artificial product manufactured in Prussia. The number of materials from which aluminum may be reduced by these processes is very large, but the strong influence exerted upon this metal by impurities reduces those ores commercially available in this country to corundum and beauxite, both of which are largely used in making low grade metal for treating iron and steel. Kryolith—natural or artificial—is another mineral that plays an important part in the commercial production of pure aluminum, since it is the best flux for alumina, the ore from which the metal is generally reduced. There is to a certain extent a diversity of opinion in regard to the value and properties of aluminum, which is partly the natural sequence to the illusions and exaggerated opinion concerning its commercial and practica- value, resulting from the romantic descriptions, speculae tions and suggestions, with which our scientific and trads literature have been filled ever since Devilles's researcher were published, and partly the result of impurities in the metal as ordinarily produced. For thirty-five years afte Deville first produced it, aluminum, though much talked of, was but little seen outside of laboratories and lecture rooms, except as we find it on the French and English markets manufactured into ornamental shapes. It is only since 1886 that it has been manufactured in sufficient quantities and at sufficiently low prices to permit practical metal workers to test its properties on an adequate scale. That very unusual qualities which give it merit, and the great depreciation it undergoes when only slightly contaminated with foreign impurites, such as iron and silicon, together with the further fact that it has only been recently commercially produced of ninety-nine per cent. purity, have a tendency to prejudice this metal in the eyes of practical people. From this depression it will slowly recover as they secure pure metal. In fact this very condition was foreseen by Deville, who very early pointed out that those handling aluminum and its alloys would be disappointed at the poor results they obtained where they used metal containing more than one per cent. of impurity.

Pure aluminum has a beautiful white color, slightly tinged with blue. It is somewhat fibrous in structure and bends considerably before breaking. If the metal contains more than one per cent. of impurity it becomes brittle and has a crystalline structure. When pure it is soft enough to be easily cut with a knife, while the addition of a few per cent. of impurities makes it exceedingly hard. It melts at a slightly lower temperature than silver, and has a specific gravity of 2.6. Taking aluminum at 1.0 the following table (from Deville), will be of interest, as showing the comparative weights of different metals:

Platinum	8.6
Gold	7.7
Lead	4.8
Mercury	4.2
Copper	3.6
Iron	2.9
Tin	2.8
Zinc	2.8
Aluminum	1.0

The pure metal takes a beautiful polish, uniting with oxygen slowly and with great difficulty, even at a red heat; and when (from long exposure) it finally acquires a very thin coating of oxide, it is not perceptibly tarnished. This coating of oxide protects it from further atmospheric or other baneful influences. It is well known that pure aluminum can be drawn out into the finest wire or into tubes; rolled into plates stamped into medals, beaten into the finest foil, etc. It has an elasticity similar to that of silver, and a tensile strength of about 26,800 pounds per square inch. The addition of six per cent. of copper, however, increases the tensile strength to that of wrought-iron, and a slight percentage of silicon raises its strength to 90,000, though at the expense of other qualities.

The compounds of aluminum formed by the addition of copper, brass or iron are unquestionably the most commercially important of the aluminum alloys. Aluminum combines with copper in all proportions, but its alloys are as easily influenced by impurities as is the pure metal. It is an important fact worth noting that, when alloys are made by mechanically mixing aluminum and copper, iron, etc., the product must be re melted a number of times to secure any uniformity in the texture of the alloy. The finest alloys, by far, are those made by uniting the aluminum to the basic metal in atomic proportions, as it is reduced, as in the Heroult process, the uniformity of whose alloys is remarkable. Probably the most useful compound of aluminum and copper is what is known as ten per cent. bronze, containing ten per cent. aluminum and ninety per cent. of copper. This alloy is an almost perfect imitation of gold in color, and is susceptible of taking and retaining a most beautiful polish. It can be rolled or drawn, or cast very readily, but in casting, the bronze shrinks considerably and care must be taken to have the feeders amply large. The tensile strength of this bronze is enormous, and the following table from "Trautwine's Engineer's Pocket Book" shows it in comparison with other metals:

	Tensile strength
Cast brass	[illegible]
Annealed brass wire	[illegible]
Cast copper	[illegible]
Copper bolts	[illegible]
Annealed copper wire	[illegible]
Gun bronze of copper and tin cast)	[illegible]
Cast iron gun metal, U. S. Ordnance	[illegible]
Average American cast-iron	[illegible]
Good wrought iron	[illegible]

[1] Read before the American Institute of Electrical Engineers, April 21, 1891.

Best American wrought iron exceptional	76,000
Iron wires, rope	38,000
Malleable iron castings	4,000
Steel plates (rolled)	81,000
Cast steel, average Bessemer ingots	63,000
Aluminum bronze, in castings, over	100,000
Aluminum bronze "special" in castings up to	130,000

Detroit Electrical Works.

It is reported that the Detroit Electrical Works has secured the backing of a strong Boston syndicate which will put $500,000 into the concern at once, thus enabling the corporation to make extensive improvements and additions to its works. The company is a Detroit enterprise, incorporated in 1876 Its principal business is the manufacture of the Rae motor for electric railways. It has many of its roads in operation throughout the country, and had the distinction of installing the first electric railway in Chicago. The company has also engaged in the manufacture of general electrical supplies The company has increased its capital from $500,000 to $1,000,000, the syndicate asking the increase, and it is to be given the benefit of a market. Hitherto it has been closely held in Detroit. The par is $10. From 1884 to 1888 the company paid cash dividends, and from 1888 to the present dividends were paid in stock, the profits going into the plant. It is intended to double the size and capacity of the works, and when these improvements are completed, say in three months, gross business per annum is estimated at from $3,000 000 to $4,000,000. The president of the company is Hugh McMillan, and the other officers and directors are Detroit business men. The American Loan & Trust company is the transfer agent.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 2.—The Rapid Transit Commission met again this week, but little or nothing has been made public in regard to its deliberations. Several West side routes were considered, but no action was taken. Frank J. Sprague sent to the commission a communication which was an exhaustive resume of the rapid transit question. He made a strong argument for the use of electric power. In the course of the document he said: "Given the incentive, and before the first foot of roadway is ready on the proposed rapid transit system of New York a 200 horse power electric motor equipment will be built which will, under forfeiture, outwork any elevated road engine for speed, pulling capacity, steadiness of work, time of operation, and continuous mileage. This statement is made from personal knowledge."

The stockholders of the Brooklyn City Railroad company have authorized the issue of $6,000,000 in 5 per cent. bonds, payable in fifty years from date Half of these are to be issued now, and the proceeds are to be used to redeem bonds now due. The other $3 000,000 is to be devoted to equipping the various roads of the company with the trolley electric system.

The state railroad commission has granted the application of the Atlantic Avenue Railroad company of Brooklyn, for permission to increase its capital stock from $1,000,000 to $1.500,000.

John Devine, a lineman in the employ of the Metropolitan Telephone & Telegraph company, fell from a pole on Fourth avenue, near Twenty-first street, last Tuesday, and was picked up dead. He was engaged in removing dead wires, one of which he attempted to cut with his pliers. This wire happened to be crossed with an electric light wire, and the shock caused the unfortunate man to lose his hold and fall to the ground. It was an open question whether death was caused by the fall or by the electric current. The physician who made the autopsy expressed it as his opinion that death was the result of the shock, although he found that there was a fatal fracture of the skull.

Warden Brush left his place at Sing Sing to-day. While he loses a rather lucrative position, he has at least the satisfaction of knowing that his name will not be associated with any attempt to kill criminals by means of electricity.

The New York *Sun* says "Warden Brush is a little proud of his machinery" for the electrical execution of murderers. This is certainly a remarkable age, and some of the officials of this great state are remarkable men.

The electric buoy system in Gedney's channel has operated extremely well during the past winter in spite of the unusual heavy gales about Sandy Hook. The six 100-candle power incandescent lamps have been of the greatest service to pilots in guiding over the bar vessels of the heaviest draught.

The newly incorporated National Automatic Fire Alarm company of Long Island will maintain lines of telegraph in the counties of Kings, Queens and Suffolk. The names of the shareholders, who are also the incorporators, are James I. Jensen, John C. Reilly and Alexander Cameron, all of Brooklyn.

The Schuyler Electric Light company is about to largely increase its Elizabeth, N. J., plant, and is building a new line of electric light poles and wires with arc lights, from the corner of Bond and Third streets, along Third to Elizabeth avenue, and down this to First street.

W. H. T.

St. Louis, Mo.

ST. LOUIS, MO., May 2 —The Pond Engineering company has erected within the last 60 days a complete plant, engines, boilers, etc., for the New Albany, Ind., Light, Heat & Power company, the power plant consisting of two Armington & Sims engines rated at 100 horse power each. It has also recently completed large contracts at Des Moines, Iowa, Seattle, Wash., and San Antonio, Tex., and, altogether, reports the outlook as very bright for a busy season.

The Western Electric Supply company, 318 North Third street, has just been incorporated, T. J. Wilson becoming the sole owner of the stock. A largely increased stock of supplies will be carried, and an active spring business is looked for.

W. H. McKinlock of Chicago and W. C. McKinlock have just returned from a business trip to their western houses located at Kansas City, Denver and Omaha, and report a very bright outlook for the Central Electric. A change has recently been made at Kansas City, Mr. Mason having resigned. W. D. Greene, until recently superintendent of the eastern department of the Michigan Telephone company, Detroit, has taken his place. The Central Electric has just secured the agency for the Packard lamp, and reports rapidly increasing sales. The company is also pushing the sale at the different agencies of the new Bryant Incandescent Socket Jas. B. O'Brien, traveling salesman for this company, has just returned from an extended trip through Texas, and is now in Iowa. He reports through all of his territory a much healthier tone than existed last year.

S. H. Terry and his associates are bringing out a new steel pole for electric street railway work which will stand any ordinary strain. A very large and powerful machine for bending the steel for these poles is being built at the power house of the Union Depot street railway line.

The Columbia Incandescent Lamp company, owing to rapidly increasing business, has been compelled to double the capacity of its factory. It is adding two new dynamos and such other apparatus as will be required. The lamp has had a large sale, particularly in the West, and the out look for next season is most promising.

The St. Louis Electric Supply company has recently removed to new quarters at 809 Locust street, and is now carrying a very large line of supplies, having a very well arranged and handsome storeroom. This company is handling Habirshaw wire and a large line of standard supplies and has just secured the sole agency for a new cut out, of which great things are predicted. It is also bringing out a new alternating current motor, to be known as the Wagner, which is claimed to have a very high efficiency. This companys, in unison with all other St. Louis electrical people, report a most promising outlook for this seson's business. H.

Pittsburg, Pa.

PITTSBURG, Pa., May 2.—The overhead wire question has been made the subject of discussion in the Pittsburg council once more, and if the ordinance, which was proposed at the last meeting, becomes a law and is rigidly enforced there will be no doubt that within a year overhead wires will have become things of the past in this city. The electric street car wires are exempt from this law, and in consequence the local companies are congratulating themselves.

There are two ordinances bearing upon the subject of wires, the first of which provides that after July 1, 1892, it shall be unlawful for any light, telegraph or telephone company to construct, maintain or operate overhead wires in the district bounded by the Allegheny river, the Monongahela river, Grant street and Eleventh street. All overhead wires and poles now in that portion of the city shall be taken down before the date named, at the cost of the owner.

The chief of the department of public safety, on July 1, 1892, shall remove all such poles or wires as may not have been removed by the owners. Violation of this ordinance is punishable by a fine of $50 to $100 for each offence.

The second ordinance relates to underground wires. It provides that any company engaged in the electric light, telegraph or telephone business prior to July 1, 1892, and which has complied with the ordinance for the removal of poles and wires, shall have the right to enter on the streets for the purpose of laying the necessary conduits and sub ways for its wires on these conditions: A plan for the proposed system shall be submitted to the department of public works, subject to approval before the work is begun; all wires shall be three feet below the surface and close to the curb, and not more than two squares of any street shall be open at one time. The street pavement must be replaced in good condition. The city shall have the right to use the conduits for the wires of the bureau of electricity. The system shall always be under the supervision of the department of public safety as far as the safety of the police and fire apparatus are concerned. Reports of the working of the system shall be furnished in detail when requested by the department of public safety,

Any company neglecting to comply with the provisions of this ordinance shall pay for every offence not less than fifty dollars nor more than one hundred dollars.

After a short discussion both ordinances were referred to the committee on public works.

In something like thirty days the Pittsburg & Birmingham traction road will be in operation under the electrical system. All the arrangements for the completion of the road by that time have now been disposed of. The company will operate the Short and the Sprague motors. The alterations on the Smithfield street bridge, which will be traversed by the company, have at last been completed. The cars and trucks have been ordered and are to be here within a short time, in fact the prospects for speedy operation of the road appear brighter than ever. It appears now that there is not another hitch and the people on the south side of this city are congratulating themselves upon the fact that they will have rapid transit before very long.

E. H. H.

Kansas City, Mo.

KANSAS CITY, Mo., May 2.—The board of public works will notify the various lighting companies with which the city has contracts exclusive of franchises not yet expired, that the present scale of prices paid for street lights will expire by order of the board on July 1, 1891. At that time the board will attempt to make new contracts for lighting that will be more favorable to the city than those now existing.

It is thought that possibly a new electric light and gas plant will be established here to enter into competition for lighting the city.

The matter of the appointment of an electrical inspector for Kansas City, which was being promoted by a committee of the Builders' and Traders' exchange, is now in the hands of the council. Speaking of the creation of such an office, E. R. Weeks, general manager of the Kansas City Electric Light company, said: "There have been surprisingly few casualties in Kansas City resulting from electric wires. I say surprisingly advisedly, for I know of some mighty poor wiring that has been done in public and private buildings. But the fact that we have had comparatively little loss does not lessen the actual need of having a good inspector at once. I don't know of a single man in Kansas City who is now at liberty who would be competent to fill the position. There are good men in the East, but they would not think of coming here for less than $2,500. The city should not allow its economical turn of mind to stand in the way of a speedy appointment of a thoroughly competent electrical inspector."

With the extension of the postal free delivery system here the telegraph companies will also make extensions. The Western Union Telegraph company will deliver messages free of any extra charge at any place not more than one mile from the terminus of any of the street railways. This will extend the limits generally to a circumference five miles away from the main office of the company. Prior to this, a charge of ten cents a mile was added for delivery within the extended limits. The revenue from this source was about $1,200 a year. The movement will place Kansas City ahead of St. Louis in delivery facilities, as the free delivery there extends to only three miles from the northeast corner of Third and Olive streets as a center.

William Giles, superintendent of construction of the West Side electric line, Kansas City, Kan., has resigned his position, and will leave for Toledo, Ohio, to superintend the construction of an electric line in that city. He has entire charge of the work of building the new line in Kansas City, Kan., and he has pushed the work rapidly. Work on the West Side line was commenced about four weeks ago, and the road will be ready for operation within two weeks' time The company has a large force of men at work building a branch line from the corner of Third street and State avenue, South on Third street to Minnesota avenue, to connect with the Fifth street cable company's line. The construction of the short line on Third street means that the merchants of Kansas City, Kan., will not derive as much benefit from the new line as they expected, as the passengers will undoubtedly do most of their trading across the line. It is likely that the matter will end in the courts, as some of the business men claim that the company has no franchise to build the short line.

The opening of Humboldt avenue from Hill street in Rosedale to the south approach of the new Eighth street bridge, for which a petition was granted by the county board yesterday, is the first step toward bringing the cities of Rosedale and Kansas City, Kan., closer together, and

at no distant date an electric road will be built between the two towns. Arrangements are being made for the extension of one of the electric roads to Rosedale during the present season.

The Argentine Water Works & Electric Light company was made defendant in a $5,000 damage suit filed with the clerk of the district court this week. The plaintiffs in the case are Mr. and Mrs. Thomas Beard, parents of Thomas Beard, Jr., who was killed March 7th by catching hold of an electric light wire. Tommy Beard, Jr., Charles Rodenback, Frank Lavery and James Fowler, all boys were walking across the foot viaduct in Argentine when they noticed an electric light wire strung along the viaduct. "Watch me get a shock," said young Beard to his companions, at the same time taking hold of the wire. He never uttered another word, for in less than a second he was dead. The current burned his hands badly, but no other marks were found on his body. In the complaint the plaintiffs allege that the defendant maintains the electric wire too near the balustrade of the viaduct, and that it was not properly insulated. They claim that the boy was seventeen years old, and capable of earning $50 per month; that they are well advanced in age, and are without means of support, except his daily earnings.

Kansas City, Kan., people are waiting to see what action will be taken in regard to the city owning its electric light works. A plank was inserted in each the Democratic and Republican platforms at the recent city conventions favoring the city owning its waterworks and electric light works. The question was thoroughly discussed during the last campaign, and it seemed to be the opinion of the majority of the taxpayers that the city should issue bonds and purchase the electric light plant, or build new works. The city now pays about $18,000 a year for electric street lights, and it is estimated that in less time than three years this amount will be doubled. There are now about two hundred arc lamps, and two hundred incandescent lamps, for which the city is paying a rental. This number is not sufficient to light the city properly. It will require at least five hundred arc lamps to furnish enough light.

P.

NEW INCORPORATIONS.

Maxstadt Electric company, Chicago, Ill.; capital stock, $100,000; to manufacture electric fuses and other devices.

Dundee Electric Light company, Dundee, Ill.; capital stock, $10,000; lighting streets, business houses and dwellings.

Union Electric Works, Chicago, Ill; capital stock $50,000; to manufacture and sell electric devices and mechanisms connected therewith.

Union Power company, Portland, Ore.; capital stock, $150 000; to furnish electricity for all purposes in Portland, East Portland and Albina.

Illinois Pulsion Telephone company, Chicago; capital stock, $5,000; to manufacture or purchase telephones, to sell or to use, and lease to others.

Colorado Electric Light company, Colorado, Tex.; capital stock $10,000; furnishing light to city of Colorado and inhabitants by means of electricity.

The Wisconsin Gas company, Chicago, Ill.; capital stock, $2,000,000; to manufacture gas, electricity or any other product for furnishing light, heat and power.

Northwest Electric Engineering company, Portland, Ore.; capital stock, $40,000; to deal in electric plants for motive power, heat and light, also to do a general supply business.

The Put-in-Bay Water Works, Light & Railway company, Toledo, Ohio; capital stock, $150,000; constructing and operating an electrical and power plant, furnishing water and light, operating an electric railroad, etc.

International Electric Railway company, Chicago, Ill.; capital stock, $2,000,000; to obtain and control patents and franchises for electrical railways, manufacture appliances and plants, furnish power and light, build cars, etc.

People's Electric Light, Power, Heat and Street Railway company, Chicago, Ill.; capital stock, $80,000; to operate street railways by electricity in Cook and Du Page counties, supply heat, power and light, and manufacture electrical appliances.

Harvey Electric, Water & Gas company, Chicago, Ill.; capital stock, $150,000; to build and maintain waterworks and works for the supply of heat, light and power by the use of electricity, gas or otherwise in Harvey, Cook county, and to build and operate a horse or dummy railroad.

ELECTRIC LIGHTING.

An electric light plant is to be erected at Attalla, Ala.

An electric light station at Bardstown, Ky., is talked of.

The project of lighting Antwerp, Belgium, by electricity has been revived.

A stock company has been formed at Ennis, Tex., to furnish electric lights.

L. N. Cox of Washington, D. C., has contracted to erect an electric light plant in Newnan, Ga.

It is reported that the South Pittsburg, Tenn., Electric Light & Power company will increase the capacity of its plant.

A number of capitalists propose to expend $75,000 on an electric light station and other improvements at Mineola, Texas.

The City Electric Light company, with a capital of $50,000, has been formed to furnish light and power in Charlestown, W. Va.

It is claimed that the new electric light plant of the Louisville, Ky, Gas company, now being constructed at Fourteenth and Magazine streets in that city, will be the largest south of the Ohio river.

The Reno, Nev., Electric Light & Power company has decided to build a suspension bridge across the Truckee river to the site recently purchased by the company. Work will also be completed on the new building for the electric light plant.

Electric train lighting appears to be regarded as successful on at least one English railway. It is reported that Bumsted & Chandler of Hednesford have recently supplied a Chandler compound engine and dynamo to the Cape Railways for the electric lighting of the trains on those lines. This is the third set of engines and dynamos supplied to the Cape Railways, two sets having been at work for more than a year. The entire weight of engine, dynamo and fittings, lamps, etc., for a train of fourteen coaches, having one hundred lights, does not exceed 1,400 pounds, and the steam consumption is not more than that required for a 6 horse power engine.

ELECTRIC RAILWAYS.

The Nashville, Tenn., Electric Railway & Power company contemplates extending its railway.

An electric road to connect the Grand Trunk and Illinois Central stations at Harvey, Ill., will be built.

The Transcontinental Street Railway company of Portland, Ore., will change to the electric system.

The Pacific Wheeless Electric Railroad company has begun work on an electric road in Aberdeen, Wash.

At Victoria, B. C., the Electric Tramway company has begun the work of construction on the new line to Oak Bay.

An electric road two miles long from Cumberland, Md., to a suburban resort known as the Seiss Grove is projected.

The Chattanooga, Tenn., Electrical Street Railway company will issue $250,000 of bonds for improving its street railway system.

The Martinsburgh, W. Va., Street Railway company has completed its organization. The motive power will, it is said, be electricity.

The South Covington & Cincinnati Railway company contemplates extending its electrical railroad at an estimated cost of $150 000.

The Hendersonville, N. C., and Brevard Railroad, Telegraph & Telephone compnny purposes to build an electrical railroad 20 miles long.

The Ontario legislature has granted a charter to a company to build an electric railroad from Niagara to Fort Erie, the whole length of the Niagara river.

So large is the volume of traffic between St. Paul and Minneapolis, on the new electric railway, that five short-line trains on the competing steam railway have been discontinued.

At Shreveport, La., the consolidation of the Shreveport City Railroad company with the Shreveport Railway, Land & Improvement company is talked of. If the deal is consummated, electricity will probably be adopted for the former line.

It is said that the Salt Lake Rapid Transit company has a longer stretch of straight track than any other electric road in the country. The portion of the line referred to is seven miles long and extends along State street in and out of Salt Lake City.

In Oakland, Cal., the Highland Park and Fruitvale Railroad company has been organized. It has secured a franchise to build an electric street railroad over certain streets in Oakland and over the Eighth street bridge. The capital stock is $500,000.

The Thomson-Houston company has just secured a franchise for an electric street railway at Cedar Rapids, Ia., seven miles in length. If the conditions are complied with within six months the rights granted become exclusive for a period of five years. The Cedar Rapids & Marion Street Railway company, operated by horses in the city of Cedar Rapids, and having a steam motor line to Marion, five miles, were applicants for the same charter, and expect now to equip the Marion line with an electric system before the close of the present season.

ELECTRIC MINING.

After citing the case of the recent explosion of fire damp in the Lehigh Valley Coal company's colliery, near Tamaqua, Pa., the *Black Diamond* of Chicago takes occasion to advocate the use of incandescent lamps in coal mines, wherever possible.

The council of the Federation Institution of Mining Engineers of England has given notice that it is desirous of receiving exhibits of miners' electric safety lamps, to be shown at the annual meeting to be held in London on May 27th and 28th.

It is reported that the famous Anaconda copper mine has been sold to a British syndicate for $25,000,000. The correctness of the statement is disputed, however. It is said that the average output of the mine is 2,000 tons of metal daily and that 4,500 men are employed.

The dynamos on the Sutro Tunnel level, which furnish power for the Nevada mill at Virginia City, in conjunction with the Pelton wheel on the surface, are now running, and the mill is being worked to its full capacity on Gould and Curry ore. This mill has a total crushing capacity of 250 tons of ore daily.

O. B. Hardy, owner of the Black Bear mine at Cœur d'Alene, Idaho, has entered into a contract with the Edison General Illuminating & Power company of New York for the construction of ten electric drills, which will take the place of compressed air drills in his mine. The amount expended for this purpose will be about $8,000.

The electric plant which has recently been installed at the Nunnery colliery, Sheffield, England, consists of an Immisch dynamo and motor, the current being transmitted from the former to the latter, a distance of 3,500 yards, by means of a cable. The dynamo is compound wound and gives 22 amperes at 520 volts, the speed being 880 revolutions. It is driven by the fan engine, the speed being obtained by means of a countershaft with pulleys, driving two leather link belts. The power required to actuate the dynamo at full load is 22 horse power. The large driving shaft is geared to the engine by a spiral form of friction clutch, and 37 revolutions per minute of the engine give a speed of 880 revolutions of the dynamo. There are two bitumen insulated cables leading from the dynamo to the motor, which is rated at 16 horse power when absorbing 525 volts and 25 amperes. The power from the underground motor is transmitted by means of a leather link belt to a countershaft. The cables are taken down the shaft in pipes, and are fixed to the props in the pit with wooden clamps. They are quite slack, so as to enable them to give way in case of a fall of roof.

The development of coal mines west of the Mississippi river during the last ten years is truly remarkable, and much more is expected during the next ten years owing to the introduction of electrical machinery. In 1889 according to the census reports there were 16,067,500 tons as against 4,584,324 tons in 1880. With the increase in the quantity of coal produced there was a gradual, though marked, decrease in the valuation of the product. For instance the valuation at the mines in 1880 averaged $1.93 per ton while in 1889 it was only $1.52. With the introduction of labor saving machinery the cost of mining naturaliy decreased and the product came within the reach of many more consumers. The quality of the coal varies in the states and territories named in the report, comprising lignite, bituminous, and anthracite, all being suitable for steam and heating purposes, while the product of some of the mines is well adapted for gas, cooking and smelting purposes. Referring to the coal deposits in Washington in which so much interest has been manifested during the last few years the census commissioners report: "The total area of the coal deposits of Washington has not yet been fully determined, but there is no doubt that almost inexhaustible supplies are at hand, not only for the future demand of its own population, but sufficient io furnish a basis for profitable traffic for transportation to the entire Pacific coast."

ELECTRIC MOTOR.

According to the *Revue Universelle des Mines*, experiments have demonstrated the correctness of the following figures showing the cost of power transmission: "1. Comparative cost on ten effective horse power transmitted 1,093 yards: by cables, 1.77; by electricity, 2.21; by hydraulics, 2.90; by compressed air, 2.98. 2. Comparative cost on fifty horse power, transmitted 1,093 yards: by cables, 1.35; by hydraulics, 1.87; by electricity, 2.07; by compressed air, 2.29 3. Comparative cost on ten horse power, transmitted 5,465 yards: by electricity, 2.64; by compressed air, 4.66; by cables, 4.69; by hydraulics, 5.29. 4. Comparative cost on fifty horse power, transmitted 5,465 yards: by electricity, 2.37; by cables, 2.65; by compressed air, 2.99; by hydraulics, 3.02. Steam was the prime motive power used in each of the above instances, and it appears that for long distances electricity takes the lead in economy over all other systems. It has also a great advantage in the facility with which the power may be subdivided."

TELEGRAPH.

It is said that the most valuable factor in carrying on the immense volume of telegraphic business between New York and Chicago, during the breaking of wires by a recent storm of was the Wheatstone instrument. During one of the most trying days, the longest time during which there were open wires between New York and Chicago was about one hour, and the Wheatstone transmitted 30,000 words in that brief space of time, thus doing the work of ten expert senders. Had it not been for this, there would have been a great load of delayed business that day.

TELEPHONE.

Senator McCormick's bill regulating telephone rentals has been favorably reported by the committee on state affairs of the Michigan legislature. The provisions of the bill are somewhat peculiar. It provides for a rental of $2.50 per month for each instrument located within one mile of the central office and twenty five cents for each additional mile. Should these provisions be unsatisfactory to the company, the bill authorizes the collection in advance of an annual rental of $12, and in addition thereto a

monthly rental based on the number of calls. If the calls do not exceed thirty per month the subscriber may be charged five cents per call; if they number more than thirty but less than 100, two cents each may be charged; if over 100, one cent. The bill requires the company to adopt one of these plans and, after notifying the secretary of state of its decision, to treat all subscribers in the state alike. The rate for state-line service is fixed at fifteen cents per message.

MISCELLANEOUS.

At Covington, Ky., the Creaghead Engineering company has been incorporated with a capital of $25,000 to manufacture various electrical and mechanical appliances.

The Electrical Development company of San Francisco has applied to Judge Wallace of that city for a writ of dissolution. The hearing on the application has been set down for May 25th.

In the United States Circuit Court in Philadelphia a decree was recently entered for the complainants in the suit of the Electric Gas Lighting company and Abraham L. Bogart against Horace A. Pinkham, enjoining the defendant perpetually from infringing on the complainants' patented improvement for lighting gas by electricity. The case was referred to a master to assess the damages sustained.

Experiments were recently made at Havre, France, with the Sims-Edison electric torpedo. Many naval experts witnessed the trials, which were carried out most successfully. The exhibition consisted of sending out torpedoes to sea propelled by electricity supplied by a stationary plant on the shore. The torpedoes were steered easily and driven at a high speed. The experiments were under the direction of Edwin M. Fox of New York.

TRADE NEWS.

The Ball Engine company is now represented in New York by E. P. Copeland & Co., 106 Liberty street. It is erecting a large addition to its works, which will be equipped with special tools

The Interior Conduit and Insulation company has removed its western office from 1105 Owings building to 435 The Rookery. H. M. Underwood continues as general western agent for this company.

Alexander, Barney & Chapin, 20 Cortlandt street, New York, announce the production of a new fibrous dry battery, said to be "a radical departure in its construction, from other forms of dry batteries now in use."

W. Hackenthal has discontinued his branch house in New York which was established to introduce the Aron Electricity Counter to the American trade. The business of the concern will hereafter be transacted directly through the home office in Berlin, Germany.

That the perforated leather belting manufactured by Charles A. Schieren & Co. of New York, is appreciated is shown by a letter recently received by that firm from the Home Electric company of Seattle, Wash. The Seattle company has two of the belts. It says of them that "they run beautifully, and are very satisfactory."

The Central Electric company, Chicago, is receiving many congratulations upon its handsome new catalogue. In acknowledging the receipt of one of these valuable documents the Waterloo, Ia., Electric company writes: "It is without doubt the finest and fullest catalogue sent out by any firm in the United States, if not in the whole world."

The Knapp Electrical Works announce that they have secured the general Western agency of the Safety Insulated Wire & Cable company's products. For the future this will be one of the most important lines handled by the Knapp Electrical Works, and their wires, which have a high standing before the trade, will be more energetically pushed than ever. The Safety company is to be congratulated on the outlet which it has secured for its goods in the West.

The Okonite base ball club, which consists of the employes of the Central Electric company, is getting in trim for the summer's campaign. It has already secured a diamond in Jackson park, near the World's Fair grounds, for Saturday afternoons in July and August, and will then be ready to meet old or new adversaries. This club distinguished itself in the memorable contest with the Kerite club, and some brilliant work by it may be expected this summer.

The Washburn & Moen Manufacturing company of Worcester is to have in its wire factory in Chicago one room which will contain two lines of the Evans friction cone pulleys of 75 horse power each. Each line will contain twelve sets of 6 horse power cones, with the driving cones coupled together, making two continuous lines of 75 horse power each. Each set of cone pulleys gives a variation of from one to nine. The speed can be changed or any cone can be stopped while the main line is running.

The Northwestern Electrical Specialty company, Chicago, of which Geo. L. Kirkham is manager, is pushing the sale of the Economic Incandescent Lamp, and is meeting with marked success, orders having been received during the last week from several prominent local users, and from several of the leading cities in the West, extending from Detroit to San Francisco. Some strong claims are made for this lamp, and the reception it is meeting with would seem to indicate that they are well sustained. Mr. Kirkham is carrying a large supply of lamps.

The New York Insulated Wire company has decided to open a store in Chicago. Quarters will be secured in the business center, on the ground floor, and a large stock of the company's well-known wires and cables will be carried. G. H. Meeker will be the manager of the Chicago store. He is well-known to the trade, and is expected to arrive in town in a few days. In the meantime J. W. Godfrey, the general manager of the company, is in Chicago making all the necessary arrangements, and looking out for the interests of the company generally.

The Electrical Engineering company is the name of a new candidate for favor in the electrical world, and one that judging from the reputation of the individuals whose names are associated together as members of the organization, ought to speedily win fame and fortune. E. M. Izard, formerly of Leonard & Izard, is the senior member of the present firm. Associated with Mr. Izard is R. H. Pierce, who was for some years with the old Western Edison company as inspector, and later with the Edison General company as State agent for Wisconsin, and R. H. Richardson, who held for six years a prominent position in the lighting department of the Western Electric company. The new company has secured the general Western agency for the Clark wire, and an agency for the Standard dynamo and the Perret motors and dynamos. With the experience had by the individual members of the company in the different lines of electrical work, their announcement that advice on electrical and mechanical subjects will be made a specialty ought to attract attention, and bring to them a successful business from the beginning.

BUSINESS.

The Chicago Motor company has removed from 169 E. Adams street to the new Springer building on South Canal street.

The Chicago Wood Mat company has just received an order from the Northern Car company of Minneapolis, for a sufficient quantity of wood matting to finish forty cars.

The Central Electric company reports large sales of the Packard incandescent lamp. It is said that the lamp is well received and is considered one of the best incandescent lamps made.

Louis Walsh, formerly with the Crosby Electric company, has been placed in charge of the open and closed circuit battery department of Alexander, Barney & Chapin of New York.

The Interior Conduit & Insulation company of New York has acquired the entire property, patents and good will of the Bergmann Manufacturing company and will henceforth make it a branch of its regular business.

Freeman, Coleman & Co., 53 and 55 South Jefferson street, Chicago, have designed and are manufacturing a novelty in the way of a business card engraved on a thin sheet of aluminum. The cards are gotten up in script or Roman letters to suit the fancy of the purchaser.

It is announced that the firm of Shurtz, Tobin & Cannon of Portland, Ore., has been merged into the Northwest Electric Engineering company. The new company represents the Fort Wayne Electric company, the Eddy Electric Manufacturing company, the Ball & Wood company, the Partrick & Carter company and the Jewell Belting company.

Messrs Wilson, Rebenstock & Co who were formerly engaged in electrical repair work and manufacturing at 174 Clark street, Chicago, have changed the style of their business house to the Union Electric Works, and have removed to room 506 Springer block, where they have fitted up a commodious factory. A number of new men are interested in the present organization which has been incorporated with a capital of $50,000. Mr. Wilson and Mr. Rebenstock are both experienced electricians and have each patented some very interesting electrical inventions, and under their management the new company will undoubtedly meet with success.

ELECTRICAL PATENTS.

Issued April 28, 1891.

451,037. Device for Regulating the Quality of Carbureted Vapor or Gas. Edward J. Frost, Philadelphia, Pa.

451,101. Electric Arc Lamp. Charles G. Young, New York, N. Y.

451,108. Adjustable Rest for Holding Electric Lamps Suspended. Cyrus A. Danals and William O. Perry, Zanesville, Ohio.

451,121. Electro-Mechanical Gong Striking Machine. Thomas F. Gaynor, Louisville, Ky.

451,125. Electric Meter. Frank K. Irving, New York, N. Y.

451,142 Electric Battery. Jean T. Van Gestel, New York, N. Y.

The invention consists of the combination in a battery and with the positive or carbon electrode thereof, of a layer or coating of binoxide of manganese applied to the face of the electrode remote from the negative electrode.

451,143. Telephone Call Box. Frank Villiers-Stead and Elward R. Hedgman, London, England.

451,149. Hanger for Electric Lamps. Peter S. Bates, York, Pa.

451,154. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

451,155. Electrically Propelled Car. Rudolph M. Hunter, Philadelphia, Pa.

451,157. Electric Signal for Railways. Uriah S. Jackson, Ossipee, N. H.

451,177. Brush Holder for Dynamos. William Le R. Emmet, East Rockaway, N. Y.

We give the fourth claim:

"In an organized brush holder, the combination of a frame, a pressure lever pivoted to said frame, means for imparting pressure to said lever, a spring-comb secured to said lever, a carbon brush, means for loosely attaching said carbon brush to said spring-comb, and a catch for holding back said brush and said comb from the commutator."

451,189. Electric Arc Lamp. John H. R. Ward, New York, N. Y.

451,190. Electric Switch. Leroy S. White, Waterbury, Conn.

451,202. Suspending Device for Electric Lamps. David P. Thomson, Lynn, Mass.

451,208. Portable Magnetic Riffle. William C. Edwards, Holyoke, Mass.

The invention relates to magnetic riffles for separating metallic particles from paper pulp, the object being to furnish a portable apparatus in which the magnetism is furnished by permanent magnets arranged and combined for effective action, and protected from contact with the pulp.

451,211. Trolley. Roderick Macrae, Baltimore, Md.

The invention consists of a frame and alternately arranged pulleys carried by pivoted vertical pintles.

451,212 Starting Device for Electric Motors. Edward P. Sharp, Boston, Mass.

The object of this invention is to control and safely graduate the amount of the electrical current passing to the motor.

451,226. Electric Indicator. John L. Ricketts, Philadelphia, Pa.

451,239. System for Electrically Supplying Hot Water for Consumption and Heating Purposes. Mark W. Dewey, Syracuse, N. Y.

451,240. Method of and Apparatus for Electrically Supplying Hot Water for Consumption and Heating Purposes. Mark W. Dewey, Syracuse, N. Y.

451,242, Armature for Electric Motors and Generators. Perrin Grant, Baltimore, Md.

The compound armature core is formed of a number of sections fitting around the shaft and having air spaces between their adjacent edges.

451,248. Advertising Clock. Frederick Redman, London, England.

451,250. Electric Arc Lamp. Addison G. Waterhouse, Hartford, Conn.

The first claim is given:

"In an electric arc lamp, the combination, with the carbon rod, of a feeding mechanism which will regulate the arc, a retarding mechanism provided with a clutch to engage the carbon rod and to travel downward with the rod, and a tripping mechanism carried by the retarding mechanism for controlling the position of the clutch."

451,267. Electric Switch. Horace T. Clark, Bridgeport, Conn.

451,268. Electric Switch Horace T. Clark, Bridgeport, Conn.

451,282. Advertising Bulletin and Train Annunciator. Spencer H. St John and Franklin A. Jennings, Chicago, Ill.

451,300. Insulating Swing Joint. Henry P. Drew, New York, N. Y.

451,308. Solenoid and Spool Magnet. Harvey S. Park, Chicago, Ill.

451,309. Electric Arc Lamp. Rupert Schefbauer, Paterson, N. J.

451,312. Regulator for Dynamo Electric Machines. Friedrich Tischendoerfer, Brooklyn, N. Y.

Claim six reads as follows:

"A dynamo electric machine having auxiliary field-magnet coils provided with independent sections, in combination with an automatic electro magnetic regulator adapted to vary the magnetic effect of the machine by varying the number of sections in circuit."

451,320 Electric Motor. Rudolph Eickemeyer, Yonkers, N. Y.

Claim two follows:

"In a reciprocating electric motor, the combination, of an electro magnet embodying a central core and an inclosing magnetic shell, affording an annular magnetic field space and a longitudinally reciprocating armature helix or solenoid provided with suitable guide bearings"

451,326. Tension and Cut-Out Device for Electric Railways. Byron Jennings, San Jose, Cal.

451 345. Method of Electric Welding. Elihu Thomson, Swampscott, Mass.

The invention consists in first heating the part of the metal to be operated upon to the proper working temperature by passing an electric current through such part, then breaking the electric circuit, and after the removal of the current subjecting such part to the action of rolls, hammers, dies or other devices.

451,364. Electric Connection. Horatio J. Brewer, New York, N. Y.

451,369. Magnetic Ore Separator. John P. Conkling, New York, N. Y.

451,370. Magnetic Ore Separator. John P. Conkling, Glens Falls, N. Y.

451,377. Safety Connection for Electric Conductors. Robert H. Gould, Berlin, Germany.

451,379. Insulator. Robert D. Haines, Corning, N. Y

451,397. Electric Switch. Henry A. Chase, Stoneham, Mass.

451,402. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

451,407. Method of Making Electrodes for Secondary Batteries. Henry H. Lloyd, Camden, N. J.

51,414. Polarized Bell. Albert Storer, Boston, Mass.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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PROVIDENCE, R. I.

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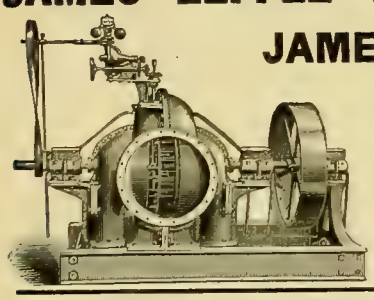

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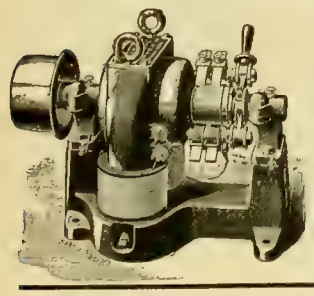

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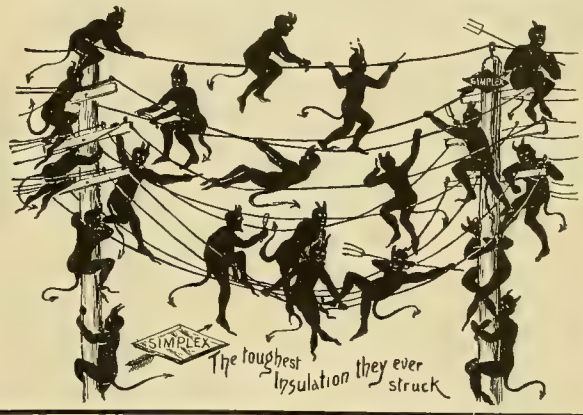

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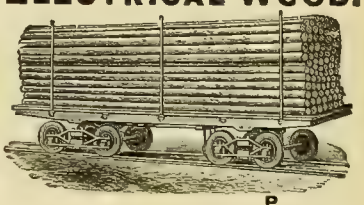

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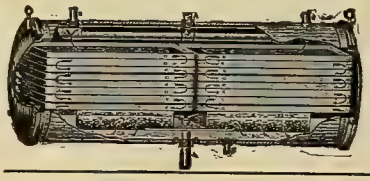

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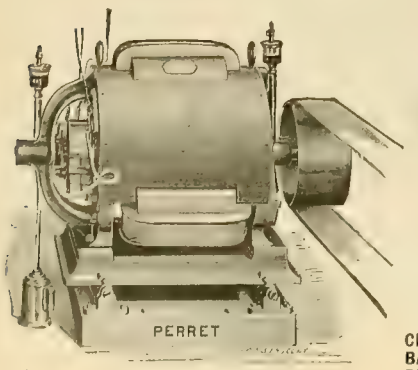

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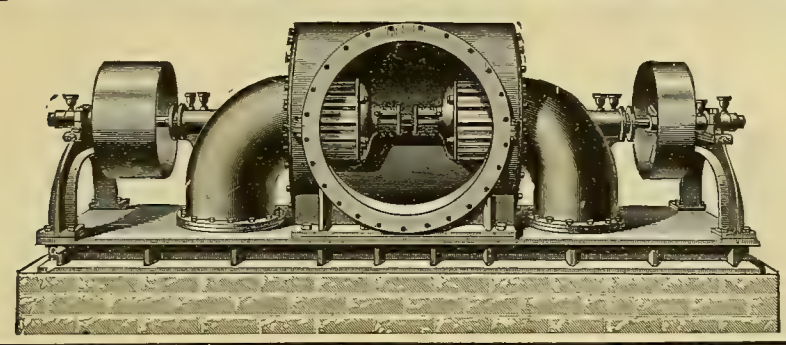

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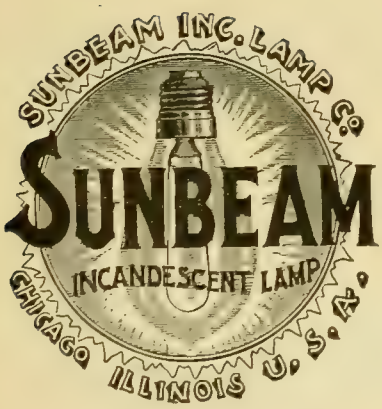

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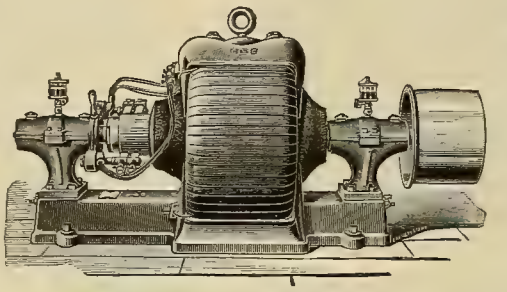

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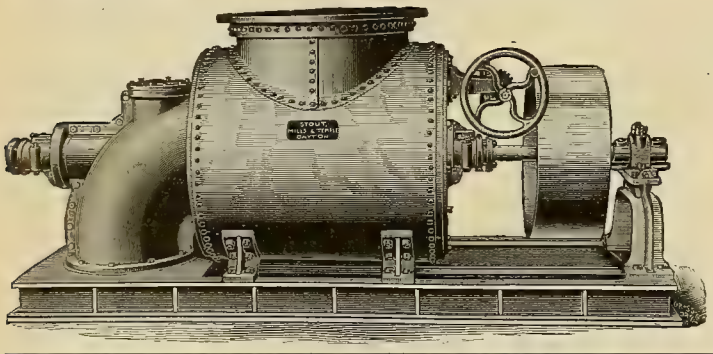

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On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

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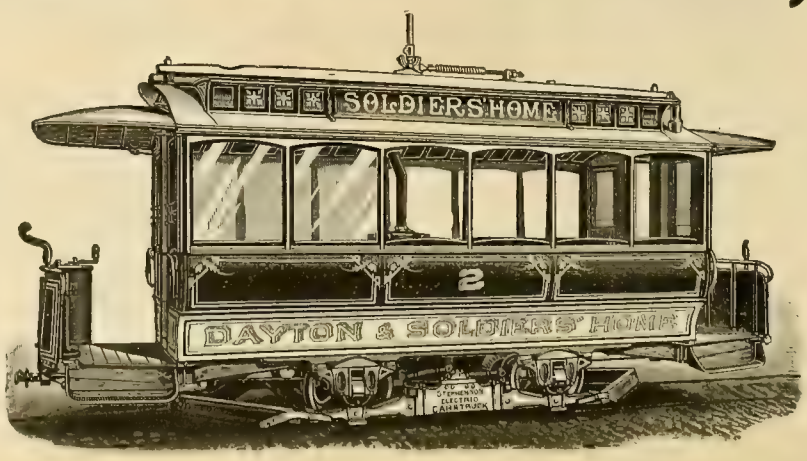

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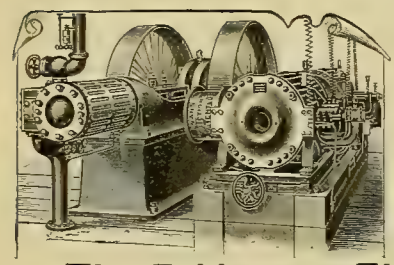
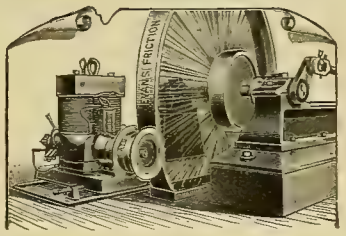
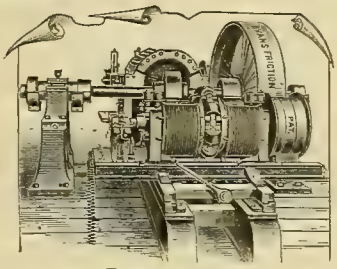
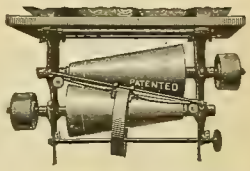

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Thousands of H. P. in use. For full particulars send for Catalogue B. Hundreds of sets of Speed Cones in use, driving all classes of machinery where a variable speed is required. For further information send for Catalogue T.

TURBINE WATER WHEELS, Horizontal AND Vertical.

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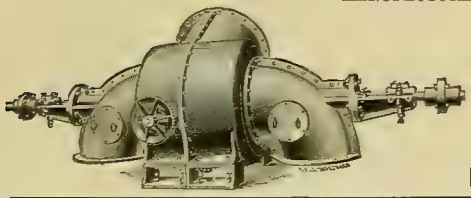
RODNEY HUNT MACHINE COMPANY.

SPECIALTIES FOR ELECTRIC LIGHT AND POWER.



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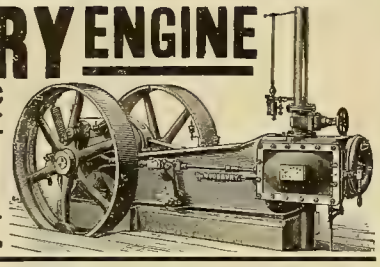

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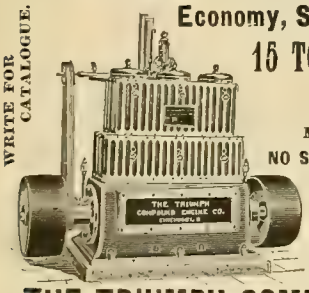

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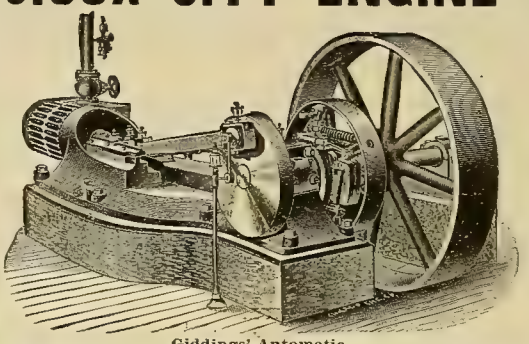

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A FEW POINTS

That seem to have won public favor may be briefly stated, as follows:

1st. The complete avoidance of the effects of lost motion on all reciprocating parts, by the self-compensation of the Single-acting principle.

2d. A high enough initial speed to admit of the Engine transmitting its ENTIRE POWER through direct-connection to the work to be done, rather than to waste a large percentage of it (and the fuel consumed) in propelling devices whose sole object is the production of requisite speeds.

3d. A complete automatic lubrication of every part, so as to provide against the frailties and weaknesses of human nature.

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5th. Through our high speeds (forbidden in Double-acting Engines) less weight per horse-power, less loss through internal condensation, less space occupied, less foundation, and less cost to the buyer.

6th. The ability to procure repairs immediately, at any time, from a complete stock always carried at Pittsburgh, instead of having to await their manufacture after a break has occurred.

7th. A minimum cost for repairs, these parts being made in large quantities and carried in stock. The total cost of repairs on all outstanding Westinghouse Engines during the year 1887 was less than one-and-six-tenths ($1\frac{6}{10}$%) per centum of the cost of such Engines to the owners.

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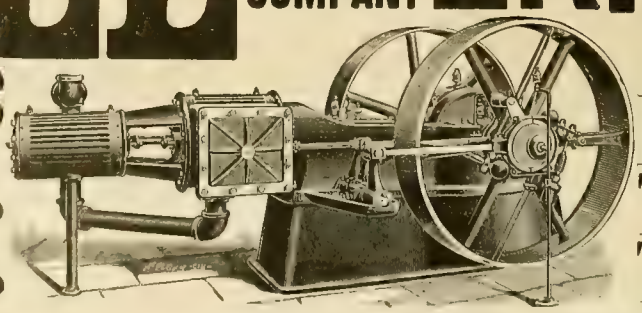

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ENGINES for ELECTRIC RAILWAY and ELECTRIC LIGHTING.

The only GOVERNOR giving ABSOLUTELY the Same Speed under all CHANGES OF LOAD or BOILER PRESSURE.

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In order to meet promptly the increasing demands for goods of our manufacture, and place them in your hands at factory prices, *thereby saving you agents' commissions and freights*, we have decided to open a Branch House in the city of Chicago, where we shall carry a complete line of GRIMSHAW WHITE CORE WIRES, TAPES and COMPOUND.

This business will be managed by our Mr. George H. Meeker, who is thoroughly conversant with the wants of the trade. Mr. Meeker will have a competent corps of assistants and the facilities necessary to enable him to execute all orders and business promptly.

Commercially speaking, "Electricity" is a fixture, and appreciating the fact that it must soon follow all other staple lines of business, whereby the consumer obtains his goods direct from the manufacturer, and as we are the pioneers in this movement, we respectfully solicit your co-operation in order to make it a success, assuring you in return the lowest prices consistent with the high standard of our insulation.

Respectfully,

NEW YORK INSULATED WIRE CO.
By J. W. Godfrey, General Manager.

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In the meantime please address all communications and orders

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Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.
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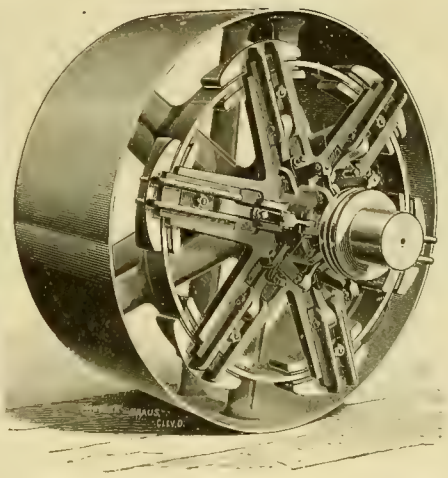

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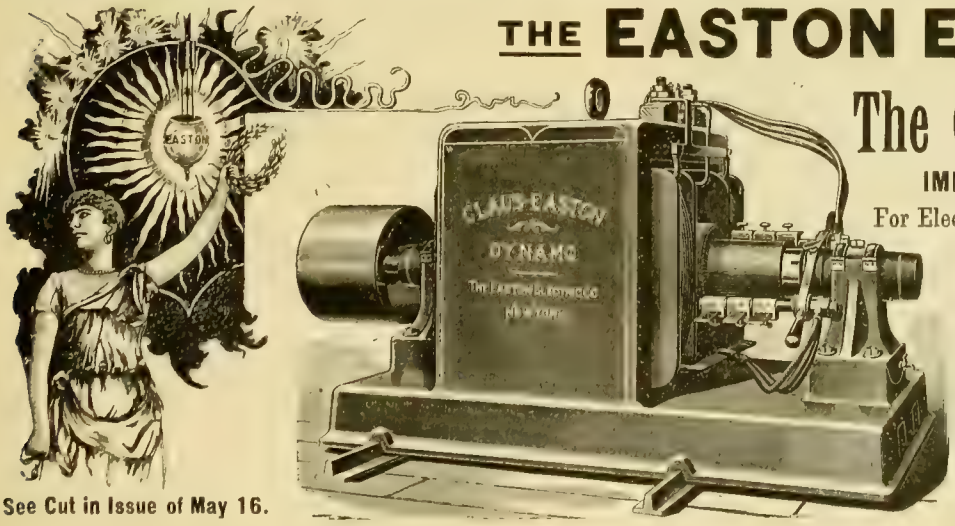

See Cut in Issue of May 16.

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The Claus-Easton Dynamo-

IMPROVED "CONTINENTAL" MACHINE.

For Electric Lighting, Power and Electro Deposition.

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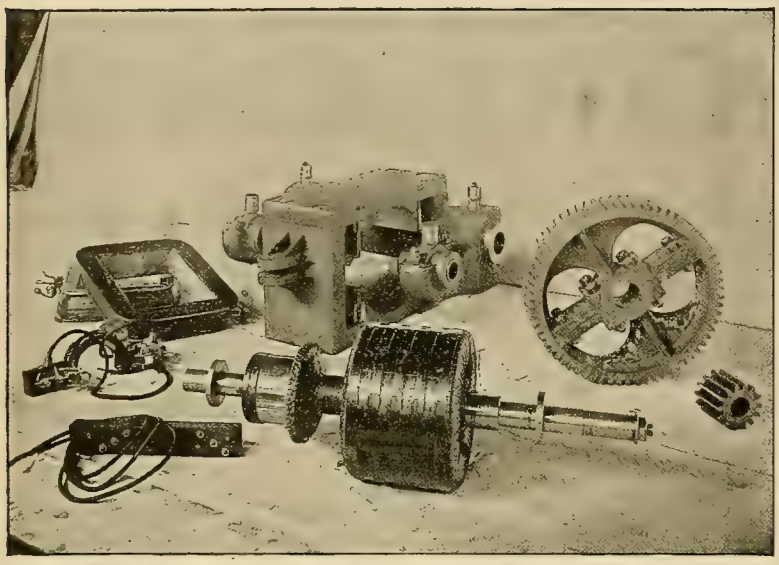
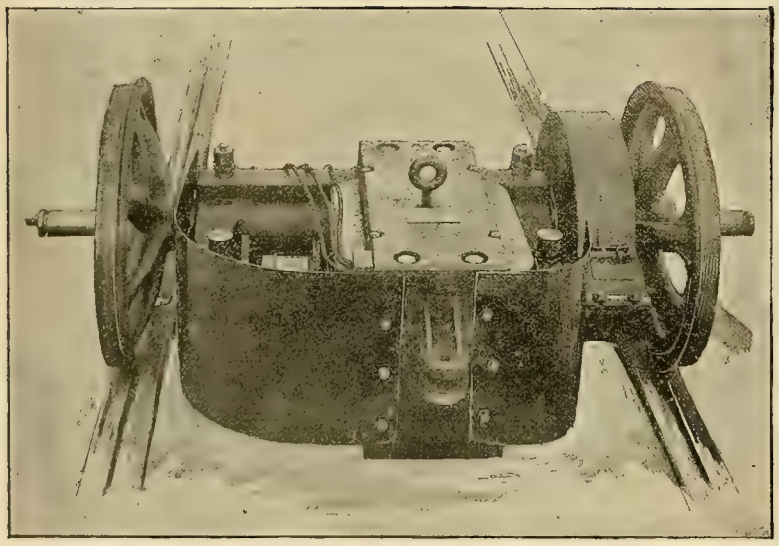
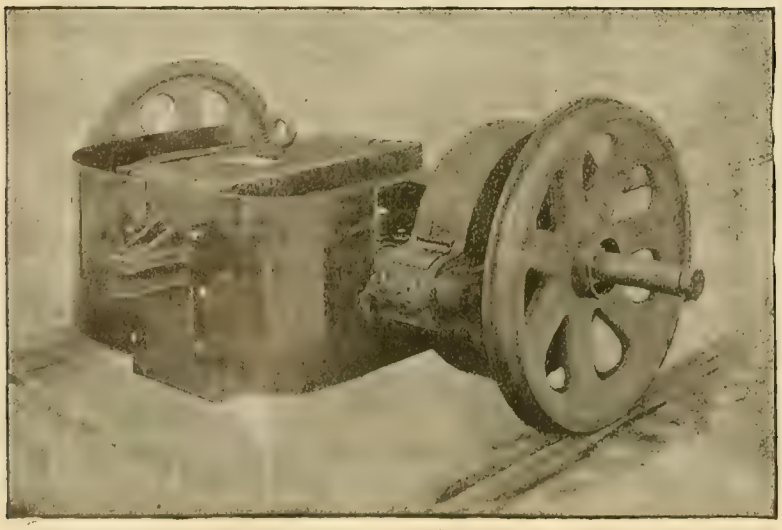
Has Revolutionized the Electrical Equipment of Street Railways.







The Intermediate Shaft, Pinion and Gear have been discarded.

The Armature Pinion and Axle Gear are now enclosed in a dust-proof case filled with oil.

Reducing to a minimum the cost for repairs and absolutely eliminating the objectionable noises incident to all other systems.

The Armature speed has been reduced from 1200 to 500 revolutions per minute.

The Railway Motor, as now constructed, comprises less than a dozen parts.

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GENERAL WESTERN AGENTS

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Fig. 6.

Fig. 14.

Fig. 7.

Fig. 2.

Fig. 4.

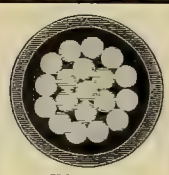
Fig. 11.

Fig. 21.

Fig. 12.

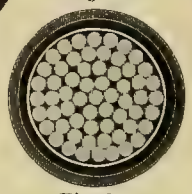
Fig. 20.

H Stands for Habirshaw, also for History.

We have both, Habirshaw and its History.

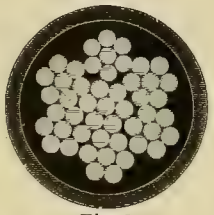
Fig. 9.

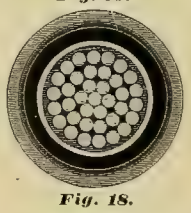
Fig. 18.

Fig. 17.

Fig. 15.

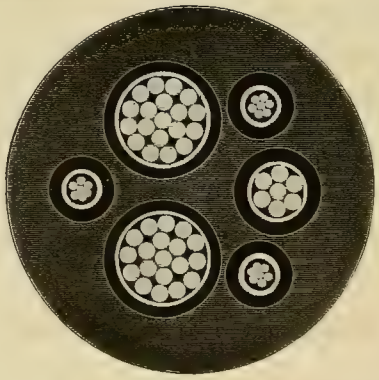
Fig. 5.

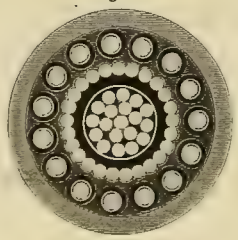
Fig. 16.

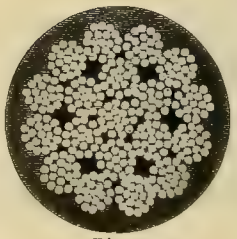
Fig. 8.

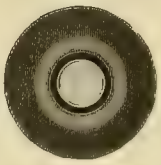
Fig. 13.

Fig. 22.

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WIRES.

Fig. 10.

Fig. 19.

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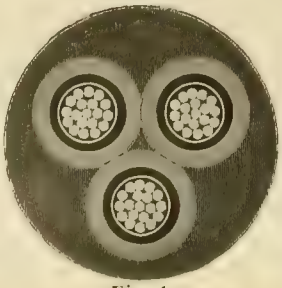
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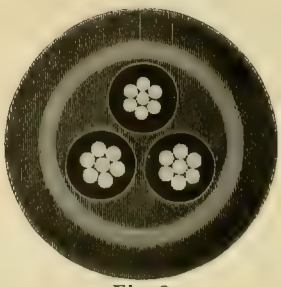
Fig. 3.

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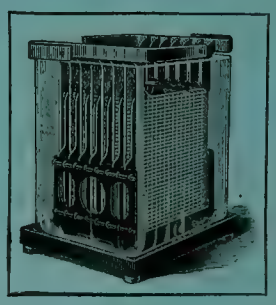

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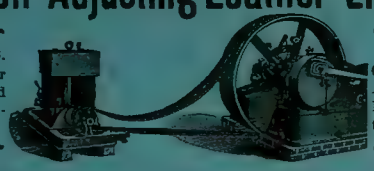

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Interior Conduit & Insulation Co.
International Okonite Co., The.
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New York Insulated Wire Co.
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Standard Electrical Works.
Standard Underground Cable Co.
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Turner Brass Works.

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Brush Electric Co.
Buckeye Electric Co.
Central Electric Co.
Edison General Electric Co.
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Great Western Electric Supply Co.
Greeley & Co., The E. S.
Heisler Electric Light Co.
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Sunbeam Incandescent Lamp Co.

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Munsell & Co., Eugene.

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Baxter Electric Motor Co.
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Great Western Electric Supply Co.
Holmes, C. H.
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Milliken Bros.
Sterling, W. C.
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Electrician Publishing Co.

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Monitor Electric Co.
Partrick & Carter Co.
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Standard Electrical Works.
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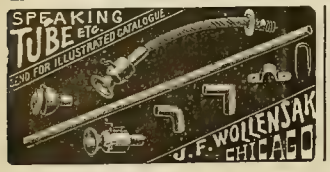

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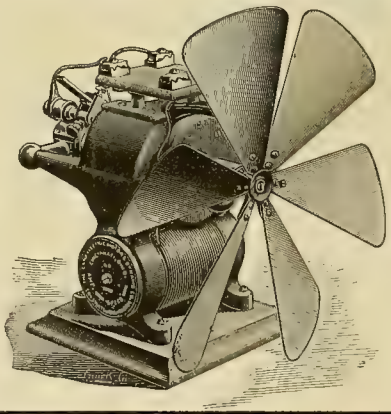

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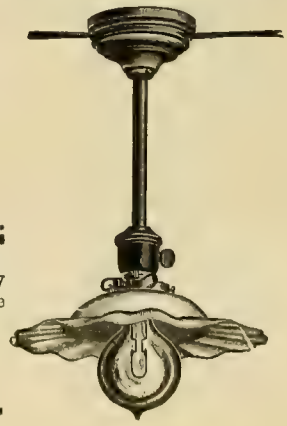

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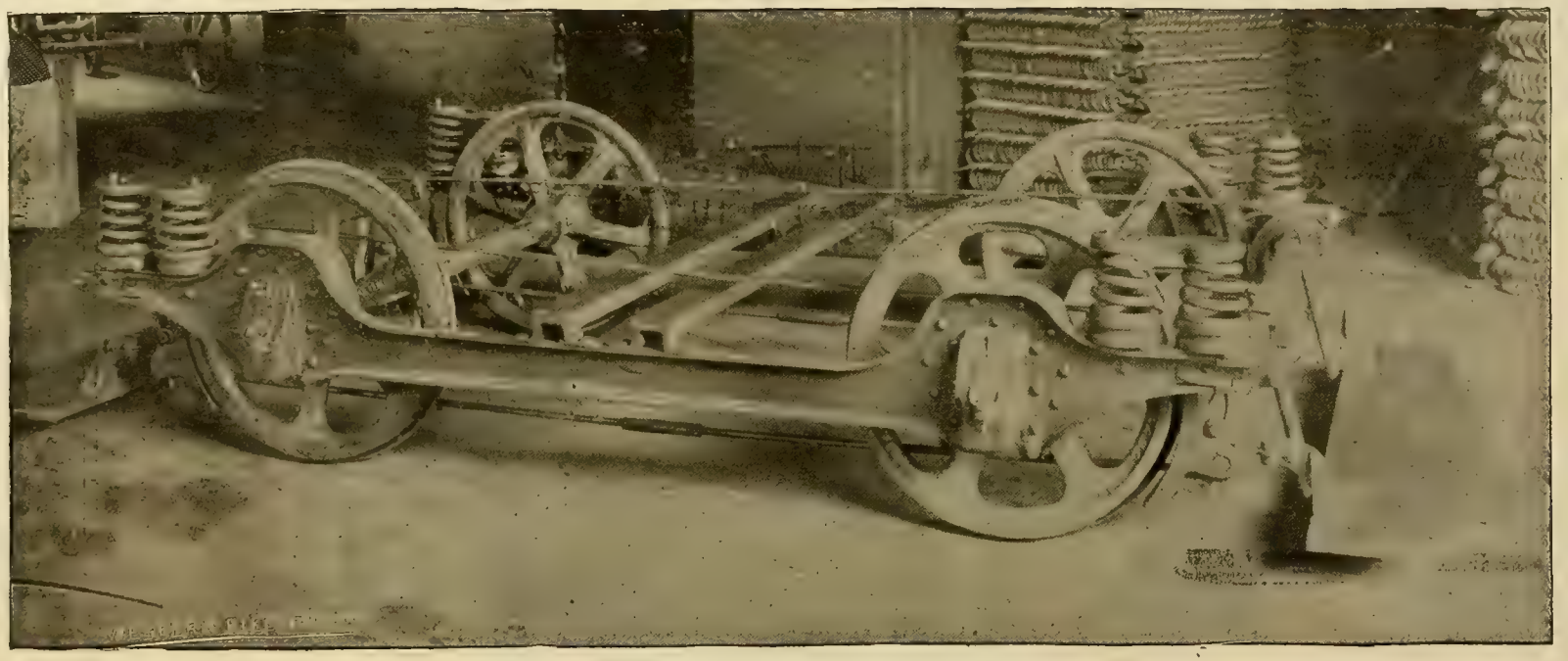

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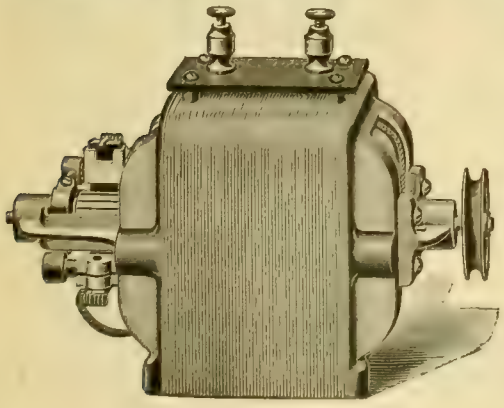

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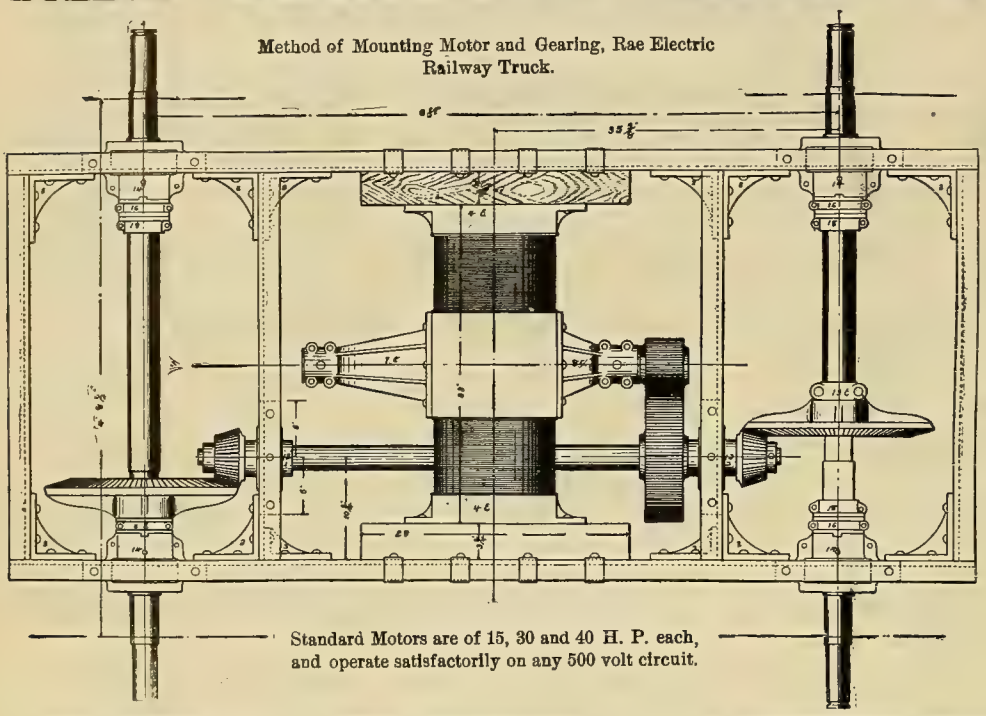

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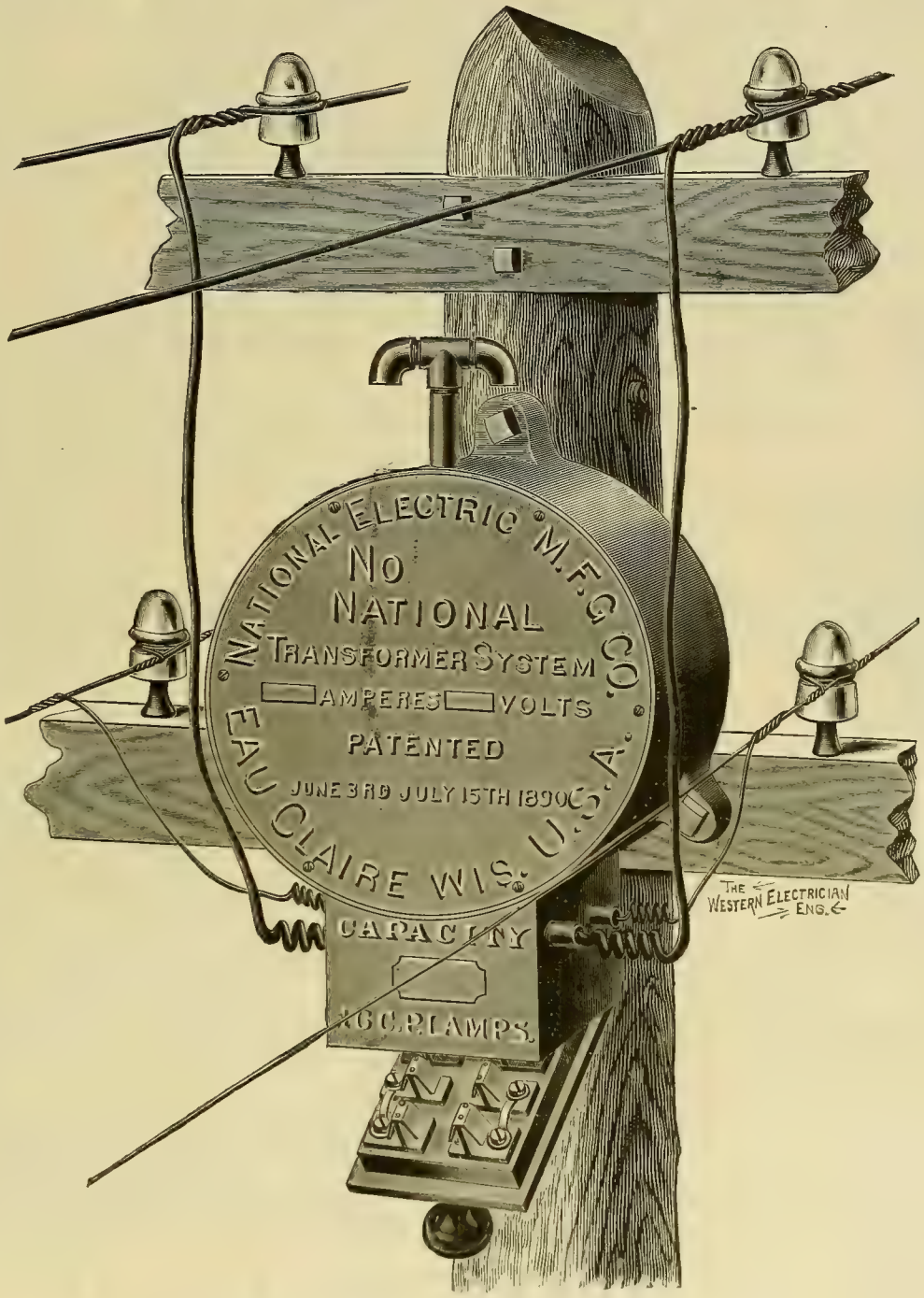

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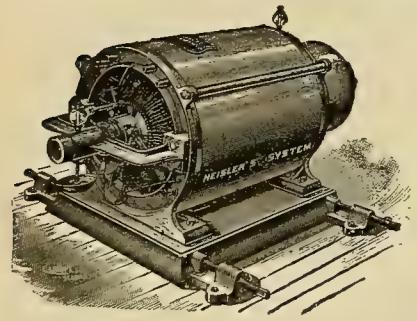

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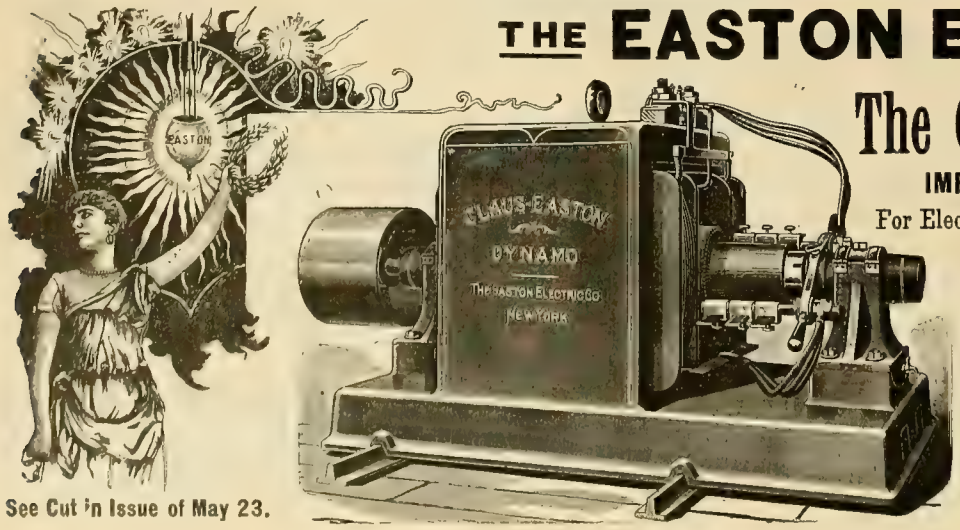

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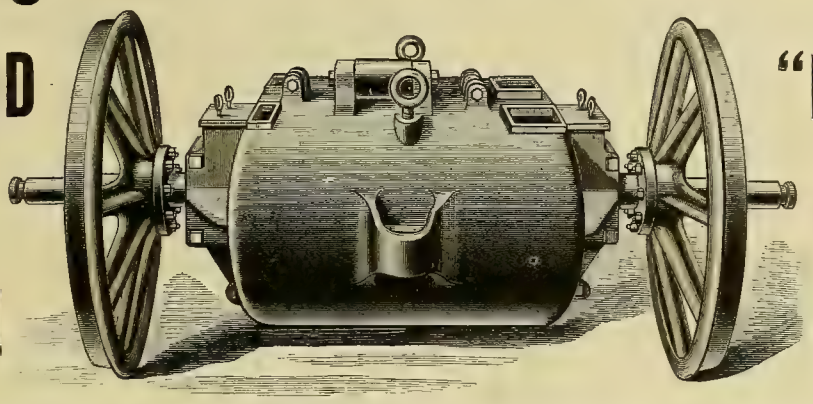

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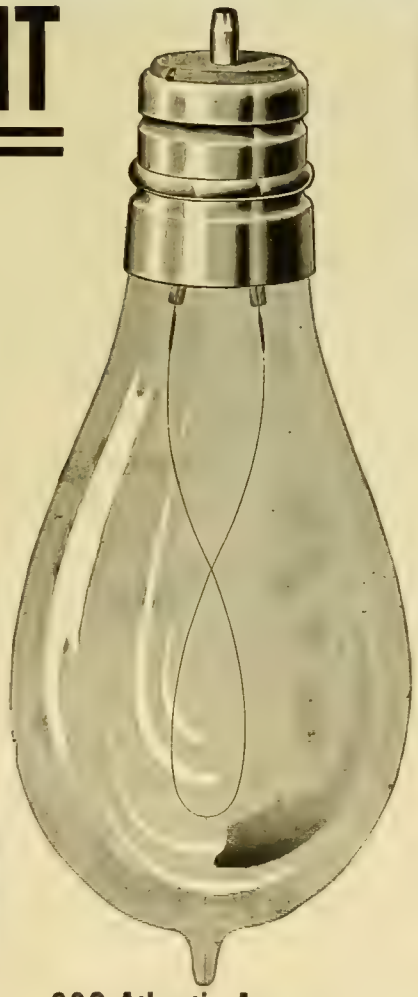
Even Diffusion of Light by twisted filament.



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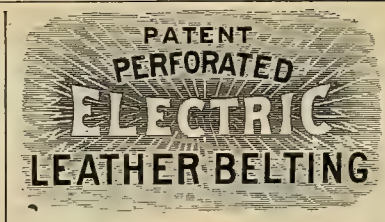

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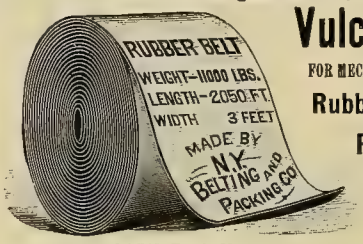

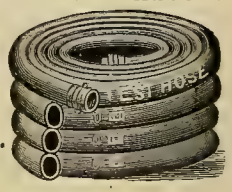

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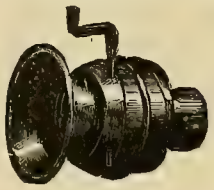

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Utilizing the Water Power at Spokane.

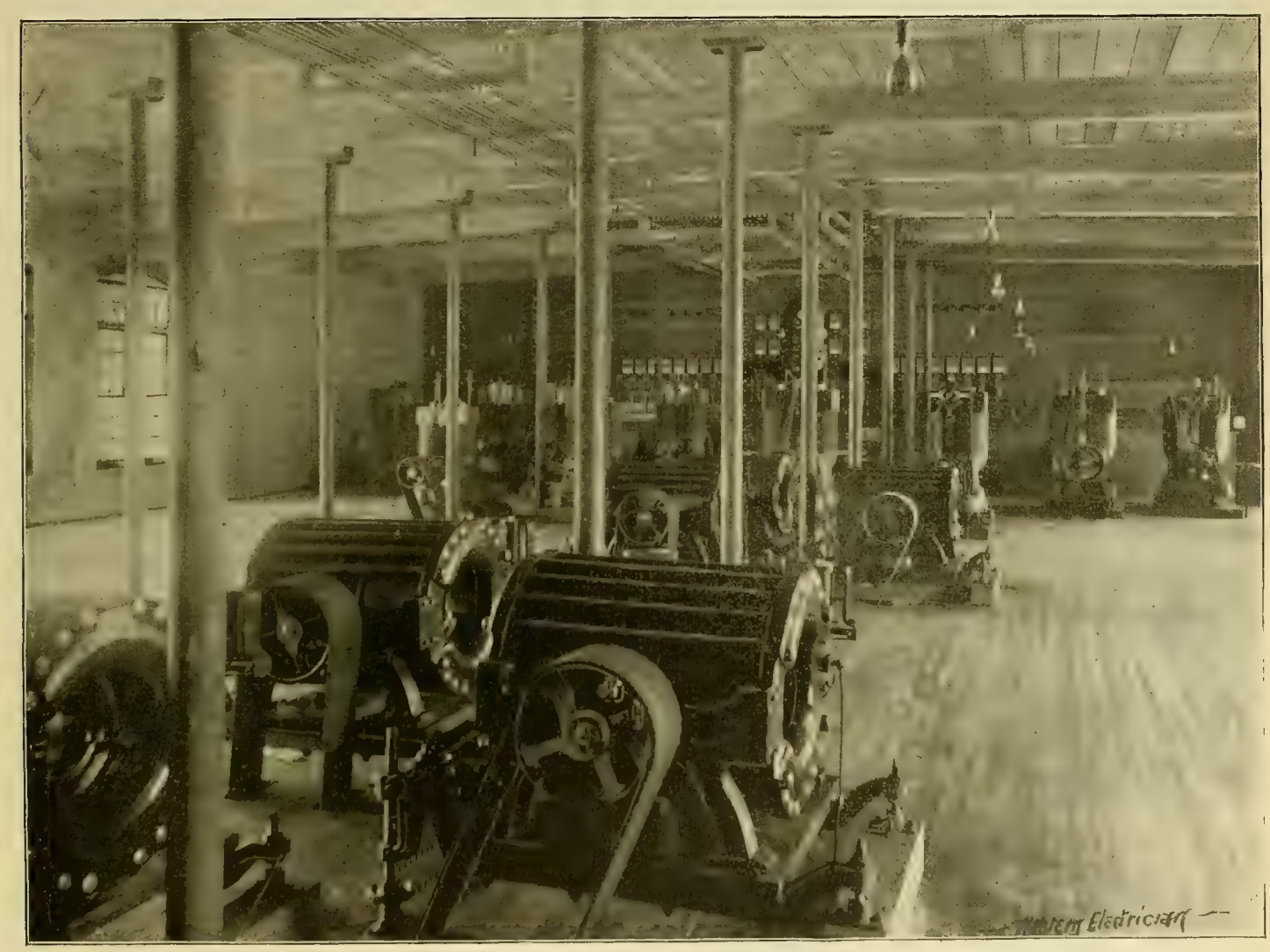
In the WESTERN ELECTRICIAN of May 24, 1890, there appeared an article on "Electrical Progress in Spokane Falls," in which was given a description of the work of the Edison Electric Illuminating company, illustrated by photographic reproductions of the architect's plans. This station is now in operation and the WESTERN ELECTRICIAN is enabled to present two illustrations from photographs of the dynamo and wheel rooms. Much interest is manifested by engineers in this station, as it is a practical demonstration of the advantages to be derived from the utilization of water power for electrical work.

This is the largest individual lighting plant on the Pacific Coast, not excepting San Francisco; and the hydraulic equipment, both in design and magnitude, is considered superior to any yet produced in any other part of the United States, if not the world.

The entire power of the Spokane river at this point is about 30,000 horse power. Within the city the river flows over a series of falls. The station is situated near the foot of the lowest and largest of these falls on the property of the Washington Water Power company. This company has just completed extensive improvements in the river at this point, and part of the work has been the construction of this station for the Edison company. The station is built on the south bank of the river at the corner of Front and Monroe streets. The floor of the station on which the water is delivered is about fifty feet below the level of the water in the dam from which the large feed pipes are taken.

The building is rectangular in form, 65x120 feet, the ends facing east and west. The foundation walls are built of granite rubble laid in Portland cement mortar, about 2,500 perch of granite and 1,000 barrels of cement having been used. The foundation walls are built thus solidly to withstand the action of the water from the draft tubes below and of high water when the river is in flood. An opening twelve feet wide is left on the west end of the foundation wall for the tail water. A solidly constructed river wall is built from the dam down to the river bank between the river and the station, affording further protection from high water. Upon this granite base is built two stories of brick with pilastered walls. The columns in the station are all of cast iron, and the floors are made of iron girders resting upon the columns, covered with corrugated iron arches supported by eyebeams, the whole being filled in with Portland cement concrete. The floor of the second story is overlaid with a thin layer of maple, upon which the dynamos immediately rest. The roof is flat, and is covered with the best slow combustion construction; and the whole station has been built with the idea of being absolutely fireproof. A large supply of hose and buckets is kept in constant readiness, and in case of fire direct access can be had to the main flumes which run through the station, so that the entire building can be flooded with water in a very few minutes. The main entrance to the building is on the east end, and an elevator and two flights of stairs furnish the necessary communication between the two stories.

The most remarkable features of the station appear, however, in its hydraulic equipments. Two parallel flumes conduct the water from the



UTILIZING THE WATER POWER AT SPOKANE.—DYNAMO ROOM.

dam to the station, a distance of about 500 feet. These flumes are each 7 feet in diameter, and are of ¼ inch tank steel. At the lower end, where the pressure is greater, the steel is 5-16 inch thick. They are capable of discharging 425 cubic feet of water per second, and of delivering 2,700 horse power. Their course from the dam partakes of an easy downward slope till within about seventy feet of the station. They then take an abrupt downward course for about fifty feet, and enter the station at its east end along the level of the first floor, continuing their parallel course to the opposite end of the building, where they come to an abrupt termination with dead ends.

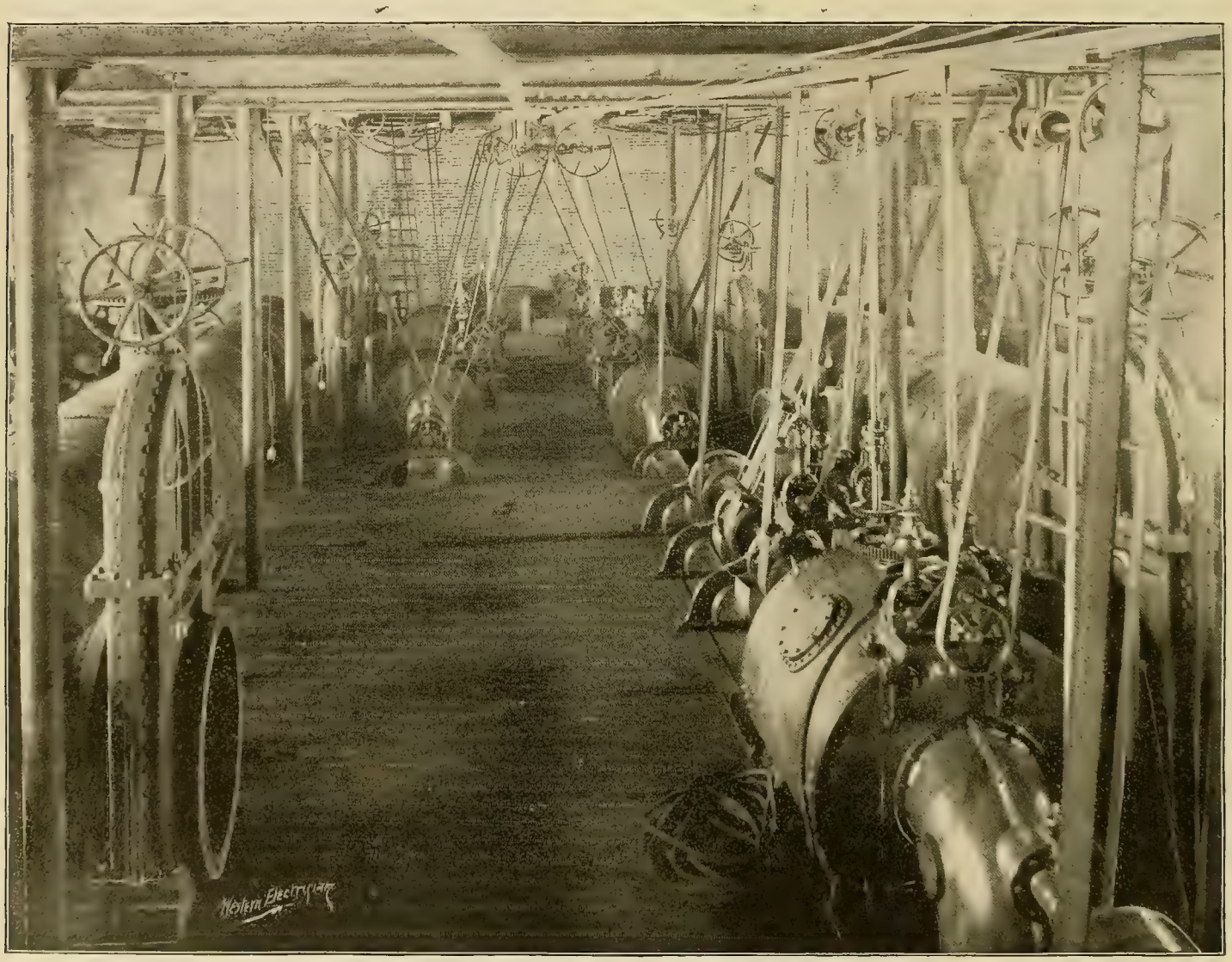
Headgates built of granite and Portland cement mortar are placed at the river dam, where the water enters the penstocks. These headgates are provided with a set of straining racks placed in front, consisting of bars of three-sixteenth-inch flat iron, the spaces between the bars being three-eighths of an inch. These racks are for the purpose of preventing foreign bodies, such as chips of wood, etc., getting into the penstocks and down into the wheels. The headgates are also provided with two different ways of regulating the water in the penstocks, and when desired the water can be entirely shut off, thus allowing men to go inside the penstocks to make repairs, should it become necessary.

The hydraulic machinery of the station is all arranged on the first floor on the level of the main penstocks. On each side of these penstocks at right angles to the same are set short branch pipes, on which are placed the wheel cases. Each penstock contains six wheel cases, three on each side. There are, therefore, in all twelve wheel cases. Two draft tubes lead from the ends of each wheel case down to the basement of the building to conduct the water away after it has passed through the wheels. Each wheel case contains a pair of horizontal Victor turbines of the Stilwell & Bierce manufacture. The pulleys are placed on the horizontal shaft on each end of the wheel case, and communicate their power by a system of direct and almost perpendicular belting to the dynamos on the floor above. The losses from friction due to intervening countershafting, frequent in stations of nearly every kind, are thus avoided. It gives the singular condition of affairs that the driving turbines run faster than the driven dynamos. Each wheel case has a pair of Snow governors, and the regulation is good. Each wheel can be regulated by hand from the dynamo floor above by perpendicular shafts with hand wheels. Each pulley in the arc department is equipped with a friction clutch, which enables it to be thrown on or off as occasion requires, independent of the others. The centers of the turbines are located twenty feet above low water, so that there can be no danger of high water interfering with their running.

The entire power of this station is 2,700 horse power, but, as will be understood from the design, this power consists of twelve different units of power, each unit independent of the others, inasmuch as there are twelve different wheel cases. This system of dividing the entire power into independent units is a very great advantage in all cases where a breakdown may occur with any part of the machinery. A gate is placed between the main penstock and each wheel case so as to enable the supply of water to be shut off from one set of wheels, should it become necessary. Thus the entire power of the station may be shut off from all the wheel cases if desired, though the main penstocks may be full of water, or one set of wheels may be shut down while all the other wheels in the station are running. At the present writing eight pairs of wheels are equipped and in operation. Of these two pairs are 15-inch and six pairs 10-inch. Each pair of the 15-inch wheels drives six 50-light Thomson-Houston arc machines, giving 375 horse power at 700 revolutions. Each pair of the 10-inch wheels drives two No. 20 Edison incandescent dynamos, giving 175 horse power at 1,000 revolutions per minute. This power is, of course, owing to the immense pressure due to seventy feet fall of water, which is exceptional, and is very rarely to be obtained. All these wheels are so nicely adjusted and run so smoothly, notwithstanding their high rotative velocity and power, that there is no perceptible vibration on the wheel cases containing them. All the incandescent dynamos of the station deliver their current to one set of bus bars.

At the present time about 1,500 horse power is used for the generation of electricity in the station, but additions are continually being made to this amount, as the demand for light and power increases. The company has now about 500 arc and 8,500 incandescent lights in operation, and about 250 horse power in motors. The lighting capacity of the station is 1,200 arcs and 12,000 incandescents. The company is now equipping a pair of 17½-inch wheels to drive two 80-kilowatt Edison generators at 500 volts for street railway work. They will be in operation in a few weeks, and the company expects to transfer a large part of their motor service now upon the ordinary machines to these generators.

The designs of this station enable the supply of power to be absolutely uninterrupted both day and night all the year round. Several of the incandescent dynamos have not ceased to run day and night for the last fifteen months, supplying current to many motors for elevator work, printing presses, etc. All the printing presses of the city are run by electric motors



UTILIZING THE WATER POWER AT SPOKANE.—HYDRAULIC MACHINERY.

supplied by the current from the incandescent dynamos of this plant. They have been pushed continuously for the time mentioned, showing the absolute reliability of water power for electric station work. Upon entering the station where the hydraulic machinery is in operation one is impressed with the advantage of water power over steam in the way of cleanliness and comfort to the men who attend the machinery. No hissing of engines assails the ears, and there is none of the grease, dirt or ashes, or the excessive heat attendant upon the steam engine. On the contrary, the atmosphere is perfectly cool, everything is clean, and the wheels run so smoothly that there is no undue noise or commotion. No coal shoveling is necessary, and the wheels can all be cared for by one attendant, who has only to occasionally give them a little oil.

The electrical equipment of the station, which is placed on the second floor, is the most complete to be found in that section. The system of arc lighting used is the Thomson-Houston; the system of incandescent lighting is the Edison three-wire. Twenty-four arc dynamos and sixteen incandescent dynamos can be placed on this floor. Each arc machine weighs about three tons, and supplies fifty lights; they have a speed of about 820 revolutions. There are at present nine Thomson-Houston machines in operation; also two American machines and one Brush. There are eleven circuits in operation, and their total length is over sixty miles. The longest arc circuit is over twelve miles in length, and the shortest about three miles.

The overhead system of distribution is used by the company. For this purpose there are over 1,000 poles in use, fifty feet in length over all, of 9 and 10 inch tops. They are all of green cedar, straight and sound, set at the outer edge of the sidewalk.

The motor service performed by the company is unusually large, as electricity for motive power is generally used throughout the city, this being largely due to the cheap rates at which the company is able to supply the current. All the printing presses and most of the elevators of the city are run by the electric current. Fans for cooling and ventilating purposes, and motors for driving sausage machines, pumping water, etc, are used in large numbers. In fact, the electric current is used everywhere in the city where motive power is required, from driving sawmills, where 25 horse power motors are used, down to running the delicate mechanism of electric clocks. The total power in use for motor purposes approximates 250 horse power, and it keeps four No. 20 machines tolerably well loaded all day.

The hydraulic equipment of the station was designed and superintended by Henry A. Herrick, M. A., S. C. E., and the electrical part of the work was designed and placed in position by John B. Fisken, the electrician of the company; and all who have examined the station unite in saying that the entire work in its design and execution is first-class in every respect.

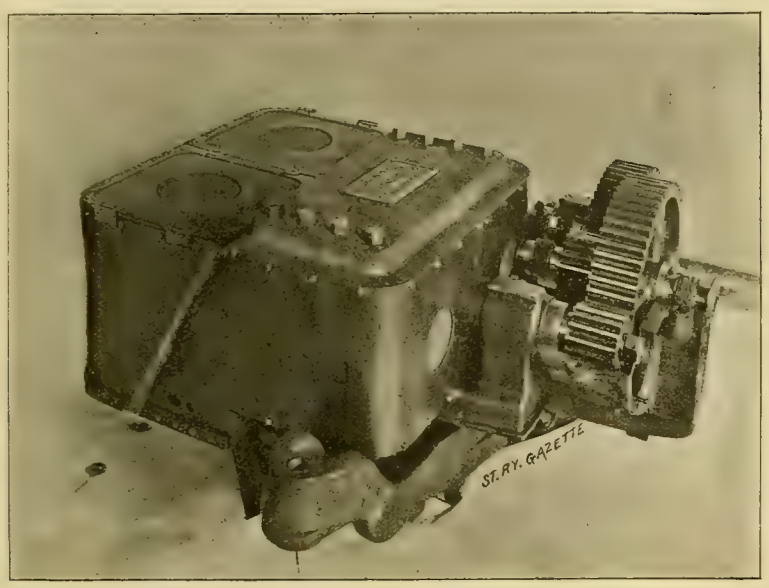
The foundation stone of this station was laid in June, 1890, and the first machines were started about the first of the present year.

The entire cost of this station has been about $100,000, about $75,000 of which was expended in the building and hydraulic equipments, and the remaining $25,000 in electrical equipments.

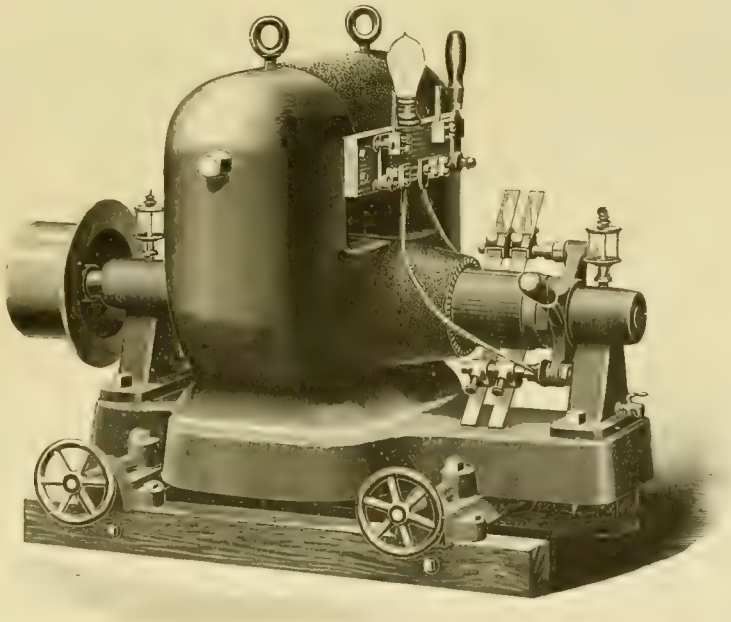
The Edison Electric Illuminating company occupies the entire lighting field of the city, and is without any rival. The rates for its lighting and power service are exceedingly low; and under the management of W. S. Norman the plant has grown from two machines capacity in an old station to its present magnitude; and it is expected that the present station will have sufficient capacity to supply the lighting needs of the city for several years to come. The capital stock of the company is $200,000, fully paid up.

The officers of the company are: F. Rockwood Moore, president; John W. Chapman, vice-president; J. D. Sherwood, treasurer; W. S. Norman, secretary and manager, and John B. Fisken, electrician.

The WESTERN ELECTRICIAN is indebted to John Mackenzie for the photographs and description of the plant.



EDCO STREET RAILWAY MOTOR.



THE HOWARD DYNAMO.

It is expected that the change from the cable to the electric system in Grand Rapids, Mich., will be completed by July 4th. Over 800 tons of new rails have been ordered, and contracts have been signed for several 200 horse power generators.

The Edco Street Railway Motor.

The Edco street railway motor, herewith illustrated, consists of two parts, the motor proper and the suspension frame with gear box. The armature is of the Gramme type, 10 inches long and 10 inches in diameter, and wound with only one layer of No. 7 wire. The core is built up of soft Norway iron disks, laminated with paper.

The pole pieces are made of soft cast iron, with wrought iron cores for the spools. The field magnets are of the Manchester type with oval spools.

The encasing is made of fiber, and protects the motor from dust. The suspension frame and gear box are cast in one piece. The upper half of the gear box is a separate casting, easily removed for inspection of gearing. The gearing is made of cast iron with steel pinions running in oil. All bearings are bushed with hard bronze and are self-oiling, requiring to be oiled not oftener than once a month. Nine of these motors are in successful operation on the Dubuque Street Railway company's lines in Dubuque, Ia. The motor is manufactured by the Electro Dynamic company of Philadelphia.

The Howard Dynamo.

It has been the aim of the manufacturers of the Howard dynamo, herewith illustrated, to produce a machine that will embody high efficiency with the simplest form of construction and fewest number of parts.

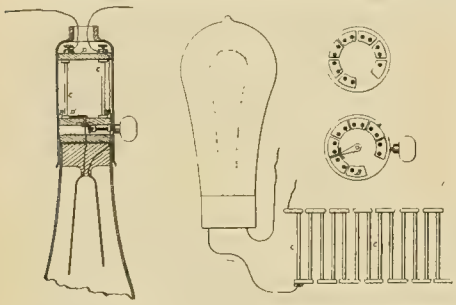
In the Howard dynamo the field magnet has an exceedingly low magnetic resistance, and from the nature of the material used and the proportions of the various parts only one coil is needed to bring the magnetism to a point at which the requisite electromotive force may be attained with a moderate speed. The core is built of charcoal sheet iron. The pole pieces are very massive castings of charcoal iron and have a sufficient cross-section to give to that part of the magnetic circuit the same magnetic conductivity as the core. The machine is compound wound. The armature is of the drum type, having the usual laminated core. Its peculiarity is the method of winding, which is done with a flat or ribbon-like conductor, wound in such a manner that a sufficient number of turns, having a large area of cross-section, can be put on the armature core still maintaining a short distance between the core and the faces of the pole pieces. In the 300 light machine, the armature has eighty turns in the conductor, the resistance of which is 0.02076 ohm. The resistance of the series coil of the field magnet is 0.00858 ohm and that of the shunt coil is 19 ohms. These machines are built in twelve sizes.

The Howard dynamos and motors are manufactured by Hiram M. Howard & Co., Cincinnati, O.

Current Regulator for Incandescent Lamps.

The illustration represents an ingenious and compact device for varying resistance in series with an incandescent lamp, and thus increasing or diminishing the light.

In the elongated socket of the lamp, Fig. 1, are placed disks *D* and *D*[1] of insulating material. To these disks are secured little metallic blocks *B* as shown, the blocks of the upper disk alternating in position with those of the

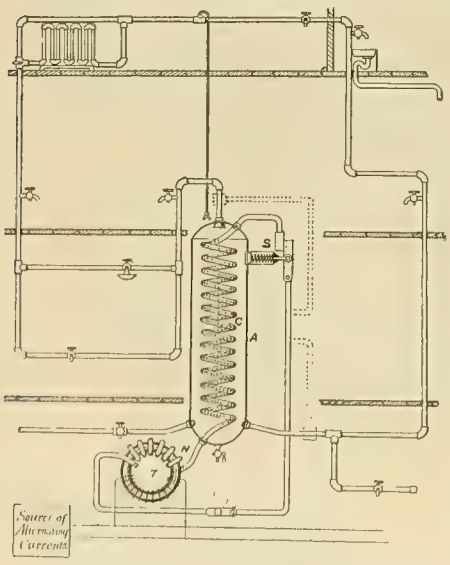


FIGS. 1, 2, 3 AND 4. CURRENT REGULATOR FOR INCANDESCENT LAMPS.

lower disk and each block, except the last of the series, being provided with two holes for receiving the ends of the small graphite pencils *C*. Fig. 2 gives a clear idea as to the manner in which the pencils and blocks are connected. Figs. 3 and 4 show the relative positions of the contact-arm, the contact-blocks and the key. In the center of the disk *D*[1] is journaled a spindle, to which is attached a little arm carrying at its free end a contact-spring which is capable of forming an electrical connection with the metallic blocks. The spindle is provided with a miter-wheel which is engaged by another miter-wheel on the key spindle. By turning the key the arm is brought into contact with the first block of the lower series, causing the full current to flow through the lamp. By further turning the key in the same direction the arm is brought into electrical contact with the metallic blocks in succession, thus introducing more or less resistance into the circuit of the lamp and diminishing its illuminating power to any desired extent. By means of this device, which is the invention of Charles H. Balsley, Jr., and E. M. Porter, Cornellsville, Pa., the lamp may be turned up or down in the same manner as a gas light.

Hydro-Electric Heating Apparatus.

The cut illustrates diagrammatically the plan of a heating system in which electricity is employed as the heating agent. In this system water warmed by electricity is distributed by



HYDRO-ELECTRIC HEATING APPARATUS.

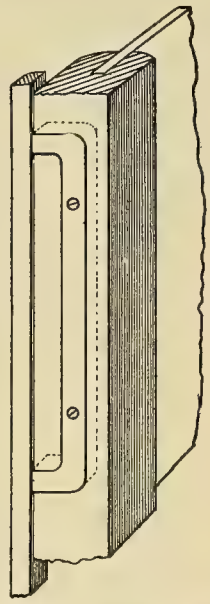
pipes throughout a building and a uniform temperature is maintained by automatically regulating the electric current. Referring to the cut, it will be seen that the inventor, Mark W. Dewey of Syracuse, N. Y., employs a peculiar form of converter *T*, having its primary coil connected in parallel across leads extending from a source of alternating currents. The secondary coil *N* of this transformer is formed of a copper rod or cable to obtain good conductivity, and its terminals connect with a perforated and coiled iron pipe *C*, which is placed as shown in the boiler *A*. The pipe *C* is of higher resistance than the conductor forming the transformer coil and constitutes the heating conductor for the boiler *A*. The perforations allow the water to circulate within the pipe, and the surface area of it in contact with the water in the boiler, is thereby greatly increased.

To automatically control the heating of the water in the boiler *A*, a pressure cylinder, *S*, having one end opening into the boiler, is provided. A pivoted connection in circuit with the coil *N* is attached to the outer end of a spring actuated piston rod. This device, it is claimed, is adapted to close the circuit through the heating conductor *C*, when the pressure in the boiler falls and to open the circuit when the pressure becomes too great.

It will be understood, of course, that on account of the low electromotive force of the electric current employed, it is not apt to leave its metallic conductor and pass through the water in the boiler. In practice, however, it may be found advantageous to coat the heating conductors or pipes with some suitable insulating paint or enamel that will not appreciably obstruct the heat.

Preventing the Rattling of Window Sashes by Means of Magnets.

The application of permanent magnets to windows to prevent the rattling of the sashes is



PREVENTING THE RATTLING OF WINDOW SASHES BY MEANS OF MAGNETS.

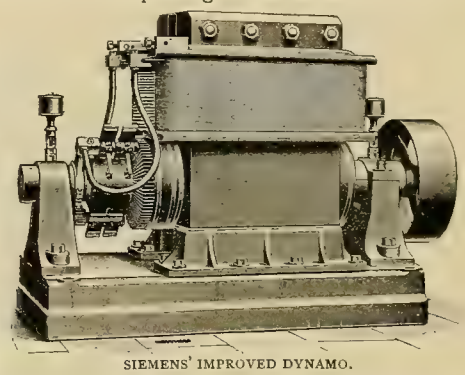
something of a novelty. It is a common practice to fit car windows snugly in their frames, so snugly that unusual dampness serves to swell the sash and render it almost impossible to raise the windows. The illustration presented herewith shows the arrangement through which Thos. N. Sterry of Norwich, Conn., seeks to overcome the difficulty.

The sash at each side is channeled to receive a bar magnet whose two poles project toward the face of the sash, and are about flush with it. Adjacent to the magnet poles, and fixed rigidly in the window frames, are rods of iron. These rods are what might be called the keepers of the magnets. The magnets being fixed in the sash act constantly to draw the sash into close contact with the frame and thus, it is claimed, overcome any tendency to rattle. A sash so provided with a magnet does not require to fit snugly in its frame and may be raised or lowered readily. While the magnets act with considerable power to draw themselves to the keepers, they do not interfere materially with the raising or lowering of the windows.

Among the tenants of the recently burned Codman building in Boston was the Redding Electrical company, which sustained considerable loss.

Siemens' Improved Dynamo.

In the accompanying cut is illustrated a compound wound dynamo with drum armature of Siemens' latest type. In this particular machine Messrs. Siemens have used wrought iron field magnets of a somewhat smaller cross-section than those adopted by many makers, and have wound the series wire on one limb only. The commutators on the machines, it is said, run without sparking. The armature is built



SIEMENS' IMPROVED DYNAMO.

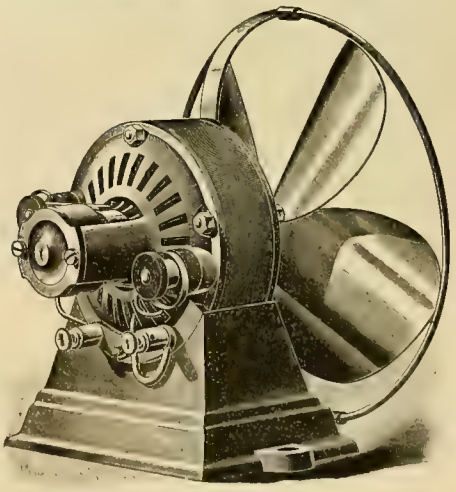
up of iron disks, and the conductors consist of strands compressed into rectangular bars, which are arranged around the outside of the armature in the usual way. The end connections are made by the Siemens method. By varying the supports of the armature and magnets, this design of dynamo can be coupled direct to any type of steam engine. At the Royal Naval Exhibition dynamos of this design are running for the illumination of the building and grounds. The illustration is reproduced from *Industries*.

Stanley Desk Fan Outfit.

The Stanley Manufacturing company, Pittsfield, Mass., has just placed on the market a new fan motor, illustrated in the accompanying cut. It is claimed for the device that the design of the motor is very compact, and, though almost minute in dimensions, it is thoroughly mechanical. The commutator is large, the shaft heavy, the brush-holder permanent in adjustment. The insulation is high, and the amount of wire on the fields and armature is extremely small. It will be seen that the general contour of the motor is such that all vital points are well protected from mechanical injury. The shaft is of steel, and the bearings large and self-oiling. The motor complete, with fan and base, weighs less than nine pounds.

Electricity Versus Cable.

The Detroit correspondent of the WESTERN ELECTRICIAN notes another important triumph of the electric rail-

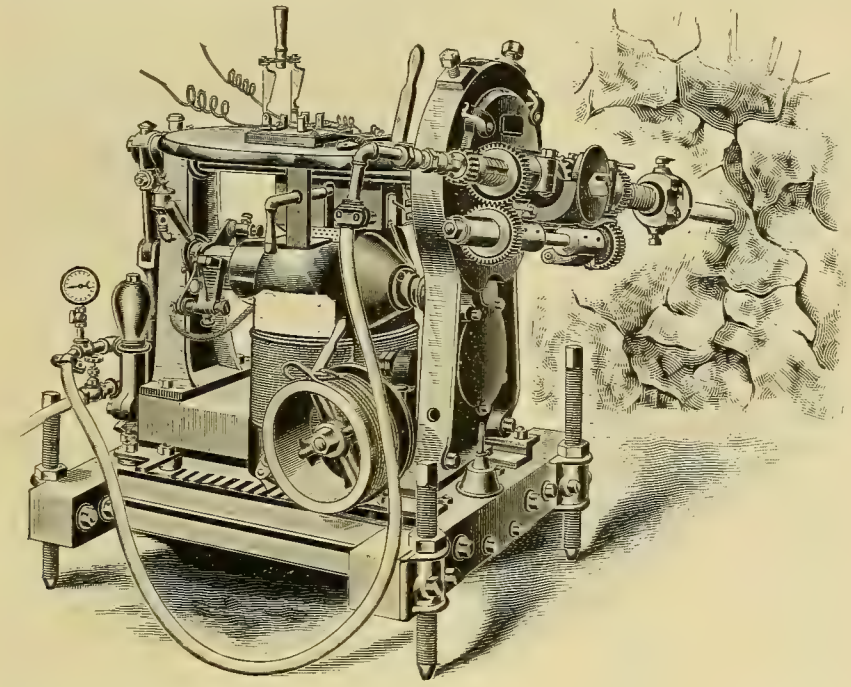


STANLEY DESK FAN OUTFIT.

way, in the recommendation of Superintendent Chapman of the Cable Street railway of Grand Rapids, that the entire system be remodeled, and that the electric motor be substituted for the cable. This determination was arrived at after a thorough investigation by Mr. Chapman, who is a practical cable engineer, formerly of Kansas City. The present system represents an investment of over $2,000,000 and it is estimated that it will cost $700,000 to reconstruct the line. This decision is especially interesting at this time when Broadway is being torn up for the purpose of introducing the cable in the most important thoroughfare of New York City.—*Electric Power.*

Electric Prospecting Drill.

The rapid development of electrical mining machinery is shown by the number of electrically operated drills now before the public. One of these is the electric diamond drill, manufactured by the Diamond Prospecting company of Chicago, illustrated in the accompanying cut. This is a prospecting drill, and is in succeesful operation by the Aspen, Colo., Mining & Building company. Its employment brings to the surface a solid core of all the rock and mineral formations, showing accurately the depth of the mineral deposit, its quality and thickness.



ELECTRIC PROSPECTING DRILL.

One of the difficulties attending the use of the diamond drill underground and in rough, mountainous localities has been to get power to the machine, as the nature of the surface of the country may make it impracticable to get heavy boilers and machinery close to the mine opening. Even where this can be done, there still remains the great difficulty and expense of getting fuel to the boilers, if the mine opening is located, as often happens, on a mountain top, where timber is scarce. And a further difficulty arises, where compressed air is not used as motive power, from the fact that the use of steam underground, besides being unsatisfactory for power and uncomfortable for the men, is often a source of great expense owing to damage caused by the action of the exhaust steam on the mine timber and rock. The application of electricity overcomes these difficulties and will permit core drilling to be undertaken to advantage in places where it has hitherto been impracticable. The dynamo can be located near an engine or water wheel and power transmitted to the drill, which can be on a mountain top, in a deep shaft, or in any part of the mine. Any constant potential electric current of sufficient capacity to deliver three horse power at the drill motor can be used. The current for running the drill can be taken from an electric plant already installed for lighting, hoisting or other mining operations, or, if no electric plant is in use for such work, a small dynamo and water wheel or engine can be put in expressly for the drill, at slight expense.

The operation of the drill will be readily understood by referring to the illustration. The device for feeding is a combination of tion of the ordinary gear feed, with a friction clutch intervening, which not only avoids danger to the diamonds, but also results in the most efficient and economical drilling. All parts of the machine, including motor, drill, pump and hoisting drum, are conveniently arranged on a single frame, which can be mounted on trucks for moving about the mine.

Two Notable Wiring Contracts.

When completed, which will be within a short time, the new Northern hotel at the corner of Dearborn and Jackson streets, Chicago, will be the loftiest in the city. The building is fourteen stories high, and is asserted to be perfectly fire-proof. The electric lights for the building will number over 3,500, and will be supplied by the Chicago Edison company, the contract having been recently signed. Current will be supplied from the Edison station, but the wiring will be done in such a manner that an isolated plant can be put in afterward if desired. One meter will be used for the entire building.

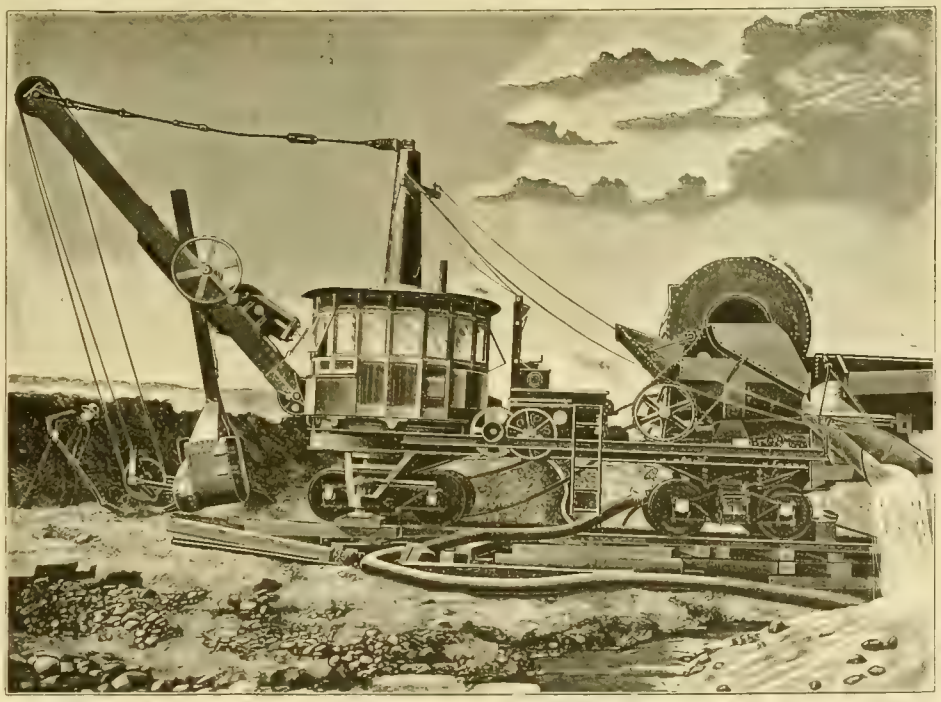
The same company has been awarded a contract to furnish lights for St. James Roman Catholic church on Wabash avenue. The church edifice will be wired for 300 lamps, the greater part of which will be grouped about the columns in series of ten and twelve. The sanctuary will be brilliantly lighted, and lamps will be placed at advantageous points in other parts of the building. It may be noted that St. James will be the first church in Chicago to be lighted by electricity. Current for these lamps will be furnished from the South Side Edison station on Wabash avenue.

Electric Motors on a Dredge and Amalgamator.

Placer mining in America, of late years, has been so unsuccessful and expensive that it seems to have become almost entirely abandoned in many good paying districts. There appears, however, to be a prospect of return to this branch of mining, not on account of better pay, but principally for the reason of the advancement in methods and machinery. Many new devices for the handling and saving of gold in this condition are being continually experimented with by capable men. In this connection, therefore, there is illustrated herewith a process and apparatus that has been before the public for some time in California and Colorado.

The plant consists of the Bennett amalgamator, dredge, electric plant and power house. The machines are built in three sizes. They are constructed of steel, and are adapted for handling cemented gravel and boulders. The dredge is arranged to be propelled forward or backward on a screw, or on its own track, by its own power, as will be seen in the illustration. Mounted on the dredge are four electric motors. One of the motors handles the dipper, another lifts it through its cut, a third swings the dipper to the hopper, while the fourth operates the amalgamator, which is upon the rear of the platform. The motors are operated by switches conveniently placed in the rotating cab, and all are under the perfect control of a single operator. These switches are arranged and connected with an electro-magnetic brake so as to reduce the number of levers requisite to thoroughly control all the operations of this plant to three, thus enabling one operator to easily handle the entire plant.

The dredge, represented in the illustration, which was taken from a photograph showing it at work near Denver, handles with ease two dippers per minute, in hard cemented gravel and boulders, such as are usually found in placer ground. While the power employed may be that from steam or water used directly, power transmitted through the agency of electricity is preferred for many and obvious reasons. The plant is adapted to run day and night, and is supplied with the proper electric lights; a 30 horse power engine is required to run this No. 1 plant, exclusive of pumping. The machine is made by the Bennett Amalgamator company of Summit county, Colorado. The cuts are reproduced from *Engineering*.



ELECTRIC MOTORS ON A DREDGE AND AMALGAMATOR.

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J. B. O'HARA, - - - - - - - - - - } Associate Editors.
F. L. PERRY, - - - - - - - - - - - }
W. E. KEILY, - - - - - - - - - - }

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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LITTLE apparent progress has been made during the week in the movement for a united exhibit and larger building for the electrical department of the World's Columbian Exposition. Electrical people have not ceased, however, to urge their claims, and the fight will be continued with renewed vigor. Chief Barrett says the heads of the great eastern electrical concerns assured him of their sympathy and support in his efforts to secure adequate space for the department. They expressed a willingness to co-operate with him as they were vitally interested in the success of the great exposition. Unless the authorities of the fair provide a building large enough for a united exhibit the companies realize that their efforts to make a grand display will be useless, and they will not expend as much time and money in arranging for the great exposition.

The committee of the Board of Directors on electricity and electrical appliances may be expected to play a more important part in the affairs of the exposition than heretofore, as its powers have been greatly increased. When the board was organized the duties and powers of this committee were extremely limited—in fact the directors seemed to look upon the committee as one of minor importance. The action last week is merely another indication of the awakening of the board to a realization of the importance of this department.

There are many other encouraging signs in the attitude of the directors toward the electrical department, but there still seems to be a lack of decision on their part. Immediate action is required if the officials of the fair desire to free themselves of the charge of endangering the success of the most important department of the great exposition. It is certainly to be regretted that so much time has been allowed to pass without definite action on the part of the directors. The electrical people were certainly disappointed at the attitude of the directors, acting under the advice of the construction department, but they are still prepared to make good their promises if they receive fair treatment, and are enabled to make a display worthy of the great industry they represent. In support of this statement the chief of the department of electricity is prepared to present the opinions of the representative electrical houses of the country. There is no division of the electrical people on this point. They are a unit in their support of the position assumed by Chief Barrett and advocated by the WESTERN ELECTRICIAN since the inadequacy of the arrangements for the department was made known.

THE Chicago *Tribune* has a curious idea of newspaper enterprise, its policy being a disgrace to the profession. It is constantly appropriating the property of others without due acknowledgment. In pursuance of this piratical policy the *Tribune* last week reproduced from the WESTERN ELECTRICIAN, without credit, the handsomely executed perspective view of the proposed electrical building presented in the last number.

ALMOST simultaneously comes the news that the launching of the coast defense ship Monterey at San Francisco by President Harrison, and the opening of the naval exhibition at London by the Prince and Princess of Wales were accomplished largely by means of electricity. The coincidence is rather curious, and affords another striking illustration of the range of application of electrical science.

THE people of Lemars, Ia., displayed excellent judgment in the emphatic manner in which they rejected the proposition to establish a municipal lighting plant. There is no doubt that the citizens desire the city streets lighted by electricity, and the merchants generally express a desire to introduce the light in their places of business, but they believe the plant should be installed by private capital, and the council will undoubtedly grant a franchise to a local company.

THE problem of utilizing the vast water powers now running to waste in the new western countries is occupying the attention of the leading engineers of to-day. Through the advancement that has been made in the application of electricity and the development of long distance transmission of power there is much to be hoped for in this line. Already there are several large electric light and power plants in this country operated by electricity, and many more will follow. In this connection the plant at Spokane, Wash., illustrated in this issue will prove interesting. It is considered one of the most complete in the country, and the exhaustive description presented elsewhere will no doubt greatly interest electrical engineers.

AN improvement which, if adopted, will result in the abolishment of the magneto from the outfit of every subscriber connected with the exchanges of the Chicago Telephone company, was described in the last issue. If the proposed device goes into service and the magneto is consigned to the scrap pile, the nervous and irritable subscriber will be deprived of the satisfaction of venting his wrath upon the harmless and irresponsible instruments. To place the telephone to the ear will be all that is necessary to effect the signaling of the exchange. The movement of the receiver-hook will send the signaling impulse out over the line. An idea of the financial value of the proposed modification may be had if it is understood that one magneto proper, leaving the bell out of the calculation, costs a telephone company in the neighborhood of $5. As the Chicago Telephone company has about 8,000 subscribers, and each of these has in his outfit one magneto generator, it does not take an expert at figures to demonstrate what an immense saving will be effected if the device proves efficient and is adopted.

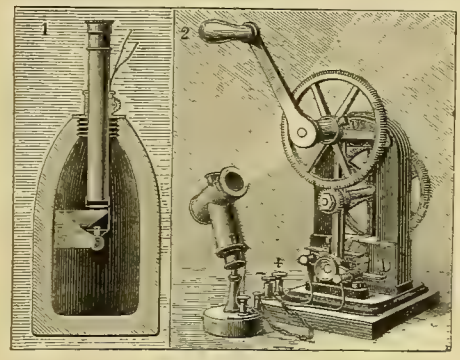
THE writer of patent specifications comes in this week for a well-deserved berating. In another column there are presented a few pertinent remarks by a contemporary relative to the verbiage of patent specifications, and it may be said that the compiler of such documents is severely but fairly criticised. Those who have had occasion to digest the lengthy and necessarily detailed description which accompanies patent drawings, in other words, to boil down, so to speak, the specification and put it into plain English, will experience a feeling not only of sympathy but of satisfaction, as they read: "He is the tedious, turgid, too effulgent parent of sonorous phrases, which mean too much, or mean nothing, according to their connection."

In how many cases do we find that document which should be drawn up, at least as far the description of the invention is concerned, in the simplest and most easily interpreted language, filled with expressions of a character apparently indicative of the writer's desire to advertise his extensive vocabulary. When we find "a hole" described as "a perforation," and, as our contemporary says, a one piece casting designated as "integral" etc., one can but wish that, if we must put up with "whereas" "here-in-before-stated" and the numberless other legal documentary trimmings, we might at least have a few facts of a descriptive nature "told in simple language that admits of no misinterpretation whatever."

A NUMBER of interesting points were brought out in the discussion which followed the paper on "Electricity in the Production of Aluminum," recently read by A. S. Brown before the American Institute of Electrical Engineers. Attention was called to the mistaken idea that all of the good properties of aluminum alloys were attributable to aluminum itself. In this connection the most common mistake has been in the belief that aluminum itself had the tensile strength of aluminum bronze. Exaggerations are also indulged in relation to the chemical properties of the metal. A freedom from oxidization has been claimed as one of its qualifications. Aluminum, it was pointed out, although not particularly liable to corrosion, if it is subjected to salt or alkaline water, or even ordinary moist air, will tarnish and oxidize rapidly. Salt water has an injurious effect upon it. Aluminum is attacked by acids and may be dissolved by alkalies. With reference to its electrical property, aluminum has about twice the conductivity of copper of equal weight, and has about half that of copper for equal volume. The above and many other interesting facts relative to aluminum were touched up in the discussion of Mr. Brown's paper. The enthusiast who looks for a great future for the metal will find his belief to be tempered somewhat after a careful perusal of the paper and discussion.

Application of the Incandescent Lamp in Artillery and Mining Service.

Commander Manceron of the French artillery has made an ingenious use of the electric light for investigating the interior of large guns and projectiles. The light is employed to as-



APPLICATION OF THE INCANDESCENT LAMP IN ARTILLERY AND MINING SERVICE.

certain if the guns or projectiles are free from flaws and cracks. Cracks would not be perceptible on the outside of the guns from the fact that most of the heavy pieces are covered with concentric steel rings. The first examination of the guns is made when they leave the foundry, another test is made after they are finished. As a flaw in the metal might not be noticed before, they are also frequently submitted to an examination after a certain number of shots have been fired.

To make the test a small incandescent lamp, Fig. 1, is placed at the end of a brass tube, blackened on the inside, and a mirror is set in this tube at an angle of 45° so that it will reflect up through the tube the light of the lamp below, which is thrown against the walls of the projectile. The lamp and tube are kept in a central position by a brass ring, which fits the opening in the projectile. Through this ring the tube can be pushed by a twisting movement until the lamp reaches the bottom, thus enabling an observer to explore every inch of the interior. The lamp is connected by a set of small wires to two binding posts on the outside of the tube. From the binding posts connection is made with a secondary battery, or a small dynamo. Fig. 2 shows the small dynamo employed. With a speed of 150 turns of the crank per minute the armature will make about 3,900 revolutions, giving a current of two amperes, at a difference of potential of 26 volts, or a capacity of 52 watts.

Commander Manceron's invention has been improved by M. Trouve, with the object of utilizing it for geological researches, and for examining the different strata in hydraulic borings. The Trouve apparatus is founded on the same principles, but the great depth to which hydraulic borings are generally made necessitates a somewhat different arrangement from that shown herewith. To this effect a short cylinder, furnished with a lamp, and protected by a wire

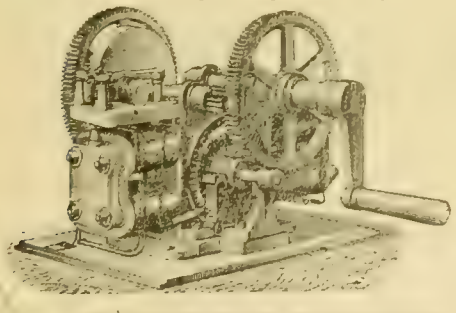


FIG. 2. MANET'S BLASTING MACHINE AND FUSE CARTRIDGE.

guard, a mirror and a reflector in the same relative position as described, are lowered into a shaft by means of two insulated wires, carrying the current for the lamp, and controlled by a windlass. The wires are fastened at the periphery of the cylinder so they do not obstruct the image of the wall of the shaft, which is formed on the reflector. The mouth of the shaft is covered by a plate having two holes for the passage of the wires. In the center of the plate is a tube supporting a telescope for the observation of the strata as they appear in the reflector on the moving cylinder. The focusing of the telescope as the distance to the object under observation increases, is accomplished by a micrometer screw. This instrument has been very successfully used by an expedition commissioned by the Portuguese government to the coast of Mozambique to explore its geological properties. The illustration is reproduced from *La Nature.*

Manet's Blasting Machine and Fuse Cartridge.

At the Paris exposition in 1889 a new electrical blasting machine, constructed by M. Manet, attracted the attention of mining engineers on account of its efficiency, obtained by an arrangement through which mechanical force was transformed instantaneously into electricity. In this apparatus the armature of a small dynamo was rotated at a high speed, and at the moment when the greatest speed was attained the power delivered was automatically and suddenly transformed into electrical energy. The current thus developed was discharged through a set of conductors to the blasting

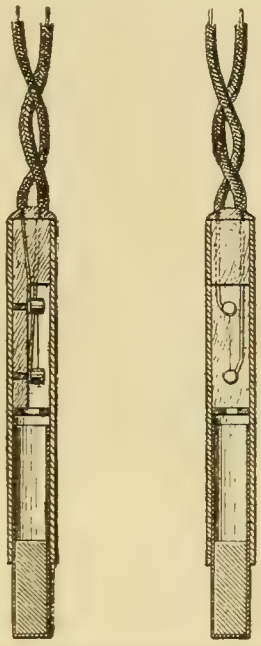


FIG. 4. MANET'S BLASTING MACHINE AND FUSE CARTRIDGE.

fuse in the mine. The automatic discharge was controlled by two metal balls, fixed on a shaft in such a way that the centrifugal force, at a certain speed, would throw them against a lever, and, displacing this, would close the electric circuit. When the discharge had taken place the balls and lever were restored automatically to their original position. This arrangement, however, proved to be too delicate for practical service in mines, as the moist air and rough usage would displace the balls and render the instrument unreliable.

Improvements have recently been made, however, and the present instrument, as shown in the accompanying illustrations, is claimed to be practically perfect.

The balls have been replaced by a weighted lever, Fig. 1, attached to one of the spokes of the gear wheel on the intermediate shaft. This lever moves inside of a fixed cylindrical box, carrying the electrical contacts. The contacts consist of two rings, insulated from each other and from the box, and are connected with two insulated binding posts on the outside of the box. The lever is kept at rest by a spiral spring, fastened to the same spoke which supports the lever, and it also carries a flat spring with a contact fastened to the end.

Figs. 2 and 3 illustrate the construction of the machine proper. It consists in the main of a small dynamo of the Gramme type, having a double ring armature with a commutator on each side. One end of the armature of this machine is wound with comparatively heavy wire, and serves for exciting the field, while the other end is wound with fine wire and feeds the outside circuit. The armature is rotated by means of gearing, arranged as shown, and the speed obtainable is stated to be 10,000 revolutions per minute. When this speed is reached the centri-

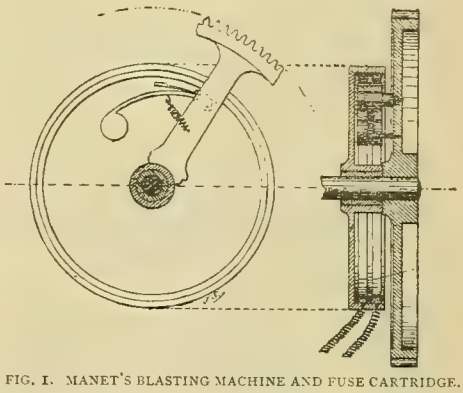


FIG. 1. MANET'S BLASTING MACHINE AND FUSE CARTRIDGE.

fugal force is sufficient to influence the lever in the contact box and overcome the tension of the spring. This action causes the weighted end of the lever to press the contact on the flat spring against the contact rings in the box and close the circuit. The interior or exciting circuit is thus rendered operative, and at the moment the magnetic field is fully saturated a small relay, on top of the dynamo, and inserted in the same circuit, Fig. 3, attracts its armature, closing the outside circuit. With the full e. m. f. thus obtained there is an instantaneous discharge of the cartridge.

The cartridge or fuse used for this machine, represented in Fig. 4, consists of a small wooden plug or holder, supporting the leading wires. Between the extremities of the wires is soldered a fine platinum wire. The holder is placed inside of a small tube, filled with powder and closed with a plug of paper or felt. The fuse wire in the cartridge is made ⅛ to 3–16 inch long for the smaller machines and 5–16 to 7–16 inch for the larger machines; its diameter is about 1–64 inch and the amount of current necessary to make it red hot is about .8 ampere. The calculation of the necessary length of the

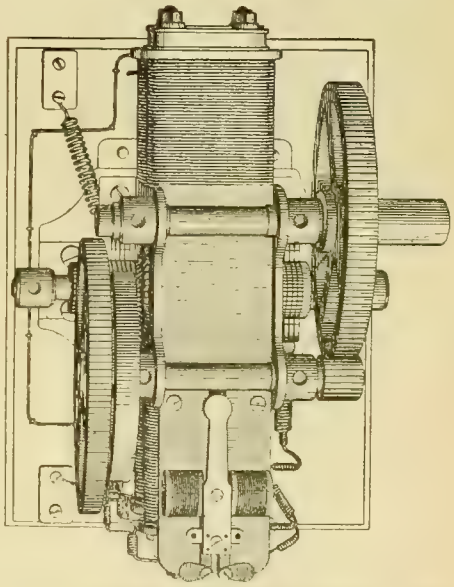


FIG. 3. MANET'S BLASTING MACHINE AND FUSE CARTRIDGE.

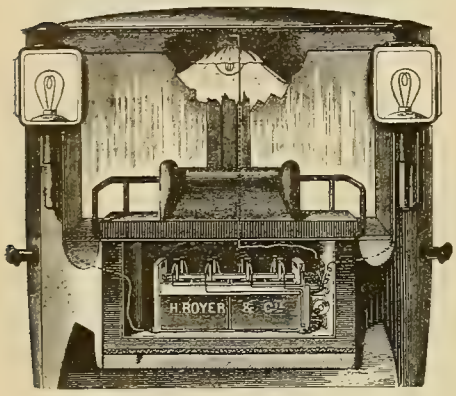
fuse in each cartridge, for a series of mines, where the resistance per inch of the platinum wire is known, is easily obtained through Ohm's law.

The Manet blasting machine is manufactured in two sizes. The larger size, intended for submarine mining service, has been introduced in the navy of Italy at the arsenal at Spezzia. This machine is 8x8x10½ inches high and weighs 22 lbs. The smaller size, for ordinary mining purposes, is 6x6x8½ inches high and weighs only 12 lbs. The electromotive force of the dynamo of the machine is 100 volts for the larger, and 50 volts for the smaller sizes. To protect the machine and render it portable, it is boxed so as to leave nothing but the crank and a set of binding posts on the outside. The illustrations are reproduced from *L'Electrician.*

Incandescent Lamps in Carriages.

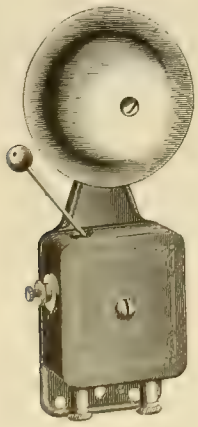
Another step in the general adaptability of the incandescent lamp for industrial and domestic purposes is shown in the accompanying illustration, reproduced from *L'Electrician*. The installation of such an outfit is no great achievement, still there are doubtless a number of the readers of the WESTERN ELECTRICIAN who will be interested to learn something as to the details of a carriage plant.

For illuminating coaches and carriages by



INCANDESCENT LAMPS IN CARRIAGES.

electric light a small battery of accumulators is placed under the coachman's box, and wires, concealed by the upholstery of the carriage, lead the current to a lamp inside, and to one headlight on each side of the box. The battery may consist of four cells, each weighing about ten pounds, of which the plates constitutes seven pounds. The space taken up by the battery, which is placed in a tight wooden box, is 8x8 and 18½ inches long, and its capacity is in the neighborhood of 48 ampere hours. The solution in the battery is made immobile by adding a cellular composition which will not materially interfere with the electro motive force of the cell. Two binding screws, one on each side of the battery box, serve to hold it in place, and at the same time form the electrical connections with the terminals of the battery. The lamps adapted for carriage lighting are of about 4 candle power, and consume about 1.2 amperes each at their maximum, consequently one charge of the battery will furnish light for about twelve hours. The interior lamp is mounted with a key and a flexible cord, and is provided with a hook by which it can be fastened to the upholstering of the carriage at any convenient point. The headlights are governed by switches, one on each side of the box, enabling the coachman to light



IRON BOX ELECTRIC BELL.

or extinguish any of them at will. Recharging the cells may be accomplished by a gravity battery so it is not necessary to remove the accumulators from their place.

The Tangent Galvanometer.

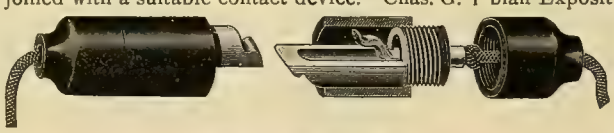
Frank Kitton, chief operator of the Western Union Telegraph company, Buffalo, read an interesting paper on the tangent galvanometer before the Buffalo Electrical society at its last meeting. The principle involved in the construction of the instrument was explained, as was also the application of the apparatus. Its employment in the Buffalo telegraph office was fully described. This galvanometer, Mr. Kitton explained, is one of the most useful and accurate instruments of measurement in service. There are about 15,000 cells of battery employed in the Western Union office in Buffalo to operate 200 circuits, of which 30 are quadruplex and 45 duplex circuits; and in order that these should be maintained to the proper standard of efficiency, it is necessary that the batteries should receive the closest attention. It is employed in the Buffalo office not only for testing the home batteries, but likewise for determining the value of currents received from distant points, and ascertaining the potential of distant batteries.

Electric Light and Scenic Effects.

Ernest Albert, the celebrated scenic artist, addressed the Sketch club, Chicago, last week, and in the course of his remarks alluded to the introduction of electric lights in theaters. He said: "And now, as to lighting, the incandescent lamp has done much for the stage. Its full, steady, glow is, when run at the proper capacity, equal to gas, while its great advantage over the latter is in its safety. With it we are enabled to place lights where formerly we could not, such as close to nets and gauzes, and hung around in groups or running along in pliable and brilliant lines of illuminating force upon the back of tree limbs or perforated set pieces of slender proportions. Great is the incandescent, and already broad is its field. The arc light is not used upon the stage for general illumination on account of its too intense shadows."

A New Trailer Connection.

On most of the electric railways the current is also used for lighting the motor car and the trailers, connection being made by flexible cords joined with a suitable contact device. Chas. G.



NEW TRAILER CONNECTION.

Armstrong of Chicago has designed the new form shown in the cut. In it the projecting ends are connected with the circuit only when the parts are slipped together, so that the device may be safely handled in any kind of weather. The contact surfaces are large, and strong spring catches insure a quick make and break. The end of each cord is soldered into a brass tube, and a knot in the cord takes the strain off this joint. The whole is made of spring brass and hard rubber, nicely finished, and about the size of the cut. It is to be placed on the market by George Cutter, Chicago.

Iron Box Electric Bells.

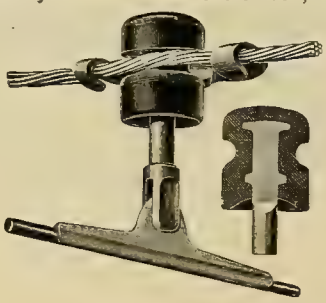
In the accompanying cut is illustrated a new iron box electric bell introduced by W. R. Ostrander & Co., New York. It will be noticed that the armature has bottom and side adjustments, and is pivoted in such a manner that, although it works very freely, the points will not get out of contact. The contact points are made of platinum wire, riveted in, and the armature spring is phosphor bronze. The hammer rod is twisted in the armature so that it will not work loose. Everything is inclosed in the box, which is held to the back plate by a center screw. The box can be removed if desired without taking down the back plate.

Electric Road between Rochester and Buffalo.

A number of capitalists of Rochester, N. Y., are interested in a project for establishing an electric railway between that city and Buffalo. It is proposed to equip the road with rolling stock capable of handling not only passengers but freight, mail and express. At a recent meeting the members discussed the question of a route from Rochester to Lockport and thence to Tonawanda and the Falls, and from there to Buffalo. If this plan is adopted Buffalo and Rochester will form the termini of the new road. A branch may run from Lockport to Youngstown. If so, it will be conducted simply as a pleasure route. A committee was appointed to visit Buffalo, Lockport and Tonawanda to confer with interested residents. these places and also to consult the city officials with reference to rights of way, etc.

The Cinch Insulator.

The insulating material used in this trolley wire insulator is comb stock rubber. The stem and yoke are of malleable iron, and the



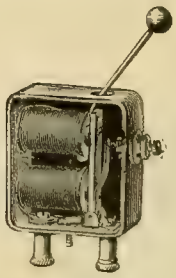
THE CINCH INSULATOR.

pin is of brass. The strains on the insulating material are those of compression. There are no screw threads or other parts subject to deterioration from exposure. The objects aimed at in the design of this insulator are great strength, high insulation, small size, convenience, durability and cheapness. This insulator is manufactured by Emmet Bros. & Griswold, New York.

Electrical Department of the World's Fair.

On Sunday last Prof. Barrett, chief of the Department of Electricity of the World's Columbian Exposition, returned from his eastern trip, which was of nearly two weeks' duration. One of the principal objects of the chief of the electrical department in making his eastern journey was to rid himself of the lingering traces of the grip, and this he has succeeded in accomplishing admirably. He returned in perfect health, only regretting that business in Chicago compelled him to come back sooner than he intended.

"I received the greatest encouragement everywhere I went," said the chief on Monday, in speaking of World's Fair prospects. "All the eastern men evinced the greatest enthusiasm on the subject, and were unanimously of the opinion that the exhibit should not be divided. I found that they had followed the trend of events out here, as depicted in the WESTERN ELECTRICIAN, closely, and that they indorsed our position at every point. They



IRON BOX ELECTRIC BELL.

assured me that the department could count on their hearty support, and I come back greatly encouraged. Of course, the big eastern companies will make displays even if the exhibit is divided among different departments, but, in that event, they will not make so much of an effort or take so much interest as they would if there was one grand, united display. And then nearly every one I talked with on the subject laid great stress on the fact that two years is to elapse before the exposition will be open and we may confidently count on great advances in electrical science during that time, thus giving greater force to our argument that adequate

provision must be made now for a united display by the electrical department."

"Did you meet Mr. Edison?"

"Yes, I met him in a social way, but I had little opportunity to converse with him about the World's Fair. But he is all right. I have a letter now from his representative, expressing Mr. Edison's cordial interest in the Department of Electricity and assuring us that he would be glad to lend his assistance if he could in any way further the interests of the department. Mr. Edison will probably be in Chicago to-morrow to attend to some business matters, and it is possible that we can then prevail upon him to give expression to his views on the subject of the electrical exhibit at the World's Fair."

When asked to give his views in relation to the lighting of the grounds and buildings at Jackson Park, Prof. Barrett said that it was his idea to give each of the various systems a chance—in other words, to allow each one of the several companies to light a certain portion of the exposition in connection with its exhibit, thus permitting of competitive tests in the matter of the greatest amount of light per pound of coal, and so on. He thought that by thus putting all systems on an equal footing, all ill feeling would be obviated and much practical good could be accomplished by carefully noting results.

An important amendment to the by-laws of the World's Columbian Exposition was adopted at a meeting of the Board of Directors held last week Friday. Before that time Col. Clowry's electrical committee was officially known as the "Committee on Machinery and Electrical Appliances," and it was "to consist of five members, to have such charge as the title of the committee indicates." This was indefinite, and it was also found that it was too much to ask one committee to take charge of the electrical department and of machinery. Mr. Arnold offered an amendment, which was adopted without opposition, changing the name of the committee to that on "Electricity, Electrical and Pneumatical Appliances." This committee "shall have jurisdiction over all matters pertaining to electricity, electrical and pneumatical appliances, and all plants connected therewith." The machinery was very properly placed in charge of the committee on manufactures. Pneumatical appliances were placed in the committee's charge because the directors—many of them, at least—thought that devices of this character were frequently operated in connection with electricity. The friends of the electrical department will be gratified by the action of the directors in placing "plants connected therewith" in charge of the committee, as this will undoubtedly pave the way for a suitable power plant for the electrical department.

Commenting upon the failure of the grounds and buildings committee of the board of directors to grant the demands of the electrical people, *Electrical Industries* says: "Such a result is a painful surprise to those interested in the success of this department, and to every candid person must seem difficult to understand. The claim that a power house would detract from the beauty of the grounds is not worthy of consideration. The exposition is to mark the world's progress, and it would be no difficult matter to design a power house that would be an ornament to the grounds, and the cartage of coal and ashes could be done at night, thus causing no discomfort to visitors. It is not too late to alter the plans, and every influence should be exerted to compel accession to the natural requirements of the department. If the change is not made, however, the responsibility for the possible failure of the electrical exhibit must rest on the engineering department, for to its stubbornness this unfortunate decision is due."

Edison in Chicago.

Thomas A. Edison arrived in Chicago on Tuesday morning. He came here on private business affairs and spent the greater part of the day in the offices of the Edison General company and the Chicago Edison company. Mr. Edison engaged rooms at the Auditorium. He was the recipient of an invitation to dine with the Chicago Electric club, of which he is an honorary member.

Substituting Electricity for Steam—From the Standpoint of the Steam Railroad Man.

At the last meeting of the Chicago Electric club, May 4th, a paper on "Substituting Electricity for Steam—From the Standpoint of the Steam Railroad Man" was read by Frank L. Perry. The paper was presented in the WESTERN ELECTRICIAN May 9th. The following is a stenographic report of the discussion:

F. E. DEGENHARDT: Mr. Perry referred, I believe, to the replenishment of the storage cells while the train was in transit on a station-along-the-route system. It strikes me that the same difficulties would arise in the transmission of the current which are at present encountered in the overhead system; that storms and various disturbances would operate against such a plan. But I appreciate the fact that he indulged in a general conjecture with no idea of advocating a system of that kind, but only to touch upon possibilities

MR. PERRY: I merely referred to the possibility of a combination between the two systems; that is the storage battery system, speaking generally, and the most common and practical system of the day, the station-along-the-route system. That is substantially the system that we have in use now. For instance, in St Paul and Minneapolis they feed, I believe, from two stations. Such a system as that might be called a station-along-the-route system. I took particular care not to state that I had worked out the details of any such equipment. And I take the stand that with even our most perfected system, namely, the station-along-the-route system, the chances of making great headway with the extensive surface roads, are slim. I make the conjecture that whatever progress we do make will, in all probability, be through the employment of a system or systems which will secure for the trains an independence, so far as motive power is concerned, from distant sources of power.

As there may be an inclination to discuss details, I will say in relation to a combination system that we may assume that our trains will start out with a storage battery fully charged, or when desirable the batteries would take current along the line, so that if the line current were cut off the batteries would tide us over. In other words batteries might be used on the railway in the same way that we now use them in the car lighting service, that is get the current from both the battery and the dynamo, and when the dynamo supply is cut off draw from the battery The idea was that there might be some such combination made in the future.

B. J. ARNOLD: It has been some time since I was in the steam railroad business, but the suggestions that Mr. Perry has just made, I think, is the nearest solution of the question to-day. There will have to be some form of locomotive that will have sufficient weight in it to give adhesion; then some way to get the current to it; either an overhead or underground conductor will have to be employed. The conductor, of course, is to be fed from stations along the line, as Mr. Perry has stated, and will carry the current, normally, directly to the motors without passing through the batteries. In case, however, of accident to the conductor, the storage batteries would relieve the danger which he mentions, of having the train stopped.

Now to my mind there is but one way to convince a practical railroad man that any system of this kind will work, and that is to build it with your own money, and then offer to partially give it to him for the reason that he is in a position where he does not wish to recommend an experiment upon which his directors are liable to lose money. I am of the opinion, though, that we will eventually pull our railroad trains by electricity, especially our fast trains, carrying moderately light loads. On suburban roads, where the traffic is heavy and the trains run frequently, we will operate on the continuous conductor principle. On longer lines, where the trains run less frequently, we will come in with the storage battery system, or some such combination as Mr. Perry suggests.

ELMER A. SPERRY: I think that the suggestion of Mr. Perry with reference to the combination of the station-along-the route system and the storage battery might be very fertile. I can hardly refrain, however, from tracing out some of the details of such a plan. Of course at first one can easily see that it would be necessary to have as few stations as possible along the route of a given line. In doing this the voltage would be run at as high a point as possible, and the method of charging the storage batteries at this high voltage without encountering very serious difficulties in the line or increasing the number of cells beyond the proper limit, is one of the problems that will probably require attention at first. Then there seems to be a tendency at the present time toward using alternating currents wherever the voltage is run up to a very high point. Of course this practice would be entirely incompatible with the use of storage cells—that is so far as we now know. If the pressure is run as low as a thousand volts, there will be over five hundred cells. If the cells were charged by direct connection to the trolley system, and a break or trouble were to occur in one of those cells, each one of them, being series, would of course tend to break or render useless a certain amount of the stored energy in one of the other cells.

Some of the most practical storage battery plants that we now have are worked in duplicate. Of course this would involve another series of the same number of cells. Taken as a whole the storage battery has not proved to be a very brilliant success when transported in railway service. I heard not long since of a special train starting from the city that was equipped with storage cells. The price paid for the storage batteries was named, and the date of starting, the date of the departure of the train, and the date when this special train returned again. It was stated that in the short period of, I think, three weeks and four days, the batteries were entirely ruined. This was about four months ago. It was supposed that the very best cells up to that time were employed in that equipment, and it was especially stated that as good a man as could be obtained was sent with the train. Now then this experiment shows me the state of the art, at the present time, of making the storage battery. Of course the people who selected the cells and placed them on the train were conversant with the different makes, and did everything they could to secure the best equipment for the money, and it was a matter of great surprise and regret to me that any such trouble should have been experienced. It has always seemed to me that a storage battery could be made to be a very valuable supplemental source of power to aid the general use of currents for different purposes. But to think of the vast amount of money and experience—over eleven years—that has been expended, and with such results, is something that is really discouraging. But then I think to the engineer nothing ought to be discouraging, and if it is possible to make the storage battery a success, it does seem as though the engineers who are now engaged upon the problem ought be able to do it.

It seems to me that railroading on a large scale will be done undoubtedly by the use of the alternating current and a transformer system. This is now being employed in Germany over quite a long line, with a degree of success that is rather remarkable. I see no reason why the trolley wire cannot be supplied by converters placed at more or less frequent intervals, and the energy transferred from stations along the route, which are very distant from each other, and in this way reduce the first cost of the line to a great extent. In this connection, as I before stated, the storage battery would be out of the question, and the engineer will have to rely entirely upon the maintenance of connection with the central station. Undoubtedly the underground system would have to be depended on, inasmuch as the effect of storms in a large system of this kind would certainly be an important element to be provided against. So far as I am concerned, I think that Mr. Perry is entitled to a great deal of consideration in the compiling of his paper, from the standpoint of good, practical common sense. I think that it may be possible that some one will ride at the rate of 200 miles by means of an electrical equipment for general railway traffic, but I do not see any way now that can be considered from the standpoint of the engineer as possible or feasible. The difficulty, or the thing that stands out against the adoption of electricity on any such a scale as is necessary in a far reaching service, is the very fact, as Mr. Perry has stated in his paper, that each train which is sent out in steam railway service is equipped with an entire power plant. This condition is due to the very fact that the engine can carry in its tender a source of stored energy, which, as compared with anything that human skill can devise, is enormously economical. A pound of coal is the standard of stored energy, and a pound of storage battery is almost zero, as compared with it, mathematically, or compared with it on the basis of the actual energy contained, pound for pound. The fact that the steam engine is enabled to utilize a substance that has, so to speak, such a vast storage of energy in it—though it is enabled to utilize only 8 or 9 per cent. of it, and coupled with the fact that that stored energy is available at such an extremely low figure as it is—seems to me to make the difficulties in the way of the electrical engineer almost insurmountable. I hope our children will be able to acomplish feats that we have read of in various papers concerning rapid travel, with electric locomotives, but I fear that the people of the present generation will be unable to do so.

MR. PERRY: Perhaps Mr. Sperry can tell me just what is the relative efficiency of any large sized alternating transformer as compared with a continuous current transformer of the same size. There are such transformers, although we do not see them on this side of the water. I should like to know how they compare in efficiency. Are they very nearly the same?

MR. SPERRY: I should think, making the statement off-hand, that they were.

MR. PERRY: Suppose we admit that the continuous current transformer has an efficiency equal to that of the alternating current transformer. Now Mr. Sperry has attacked what was, after all, only a conjecture on my part, but I can say a word in favor of it. He has spoken of the probable impossibility of using storage batteries on large railway lines from the fact that it would be a difficult matter to store the cells. To begin let us assume that we can charge at a pressure of a thousand volts, but not very satisfactorily. We must not forget that our breakdowns are not apt to be numerous. We could charge the cells at the station and use the battery as a means to tide us over the breakdown along the road. It is reasonable to assume that our overhead or underground system will carry us under ordinary circumstances; our storage batteries we only expect to carry us when we have a break. Now if we are to look at the alternating system to help us in the solution of this problem, what is the objection to introducing on the train, for service at odd times, a transformer, that is an alternating current motor combined with a continuous current dynamo? To begin with we must have an alternating motor or we can't touch the railway. Why then could we not combine a motor with a generator and use this small plant to gradually store current to tide us over possible break-downs?

MR. DEGENHARDT: In regard to one of the ideas advanced as against the possible introduction of a rapid system of the class under discussion, I will say that I do not believe that the expense would be considered. When we look at the advancement in railways, at the luxurious Pullman sleeper of to-day, etc., it does not seem to me that money will be considered. I believe that the annihilation of time would be of more value to the traveling public than the consideration of the cost of transportation. Therefore, I do not believe that this argument would be used against the introduction of a system that would enable us to travel at the rate of 200 miles an hour.

F. B. BATT: I would like to say a few words on this occasion. I always assumed—and I think Mr. Crosby of New York mentioned it in his paper, with which most of

us are familiar—that the question of speed in railway travel simply depends upon one factor, and that is the condition of the road bed, of the track, of the rails generally. He claims that if we have a straight track, a good road bed well ballasted, and very heavy rails, we can travel with our present means at a much higher rate of speed than we are doing to-day. It seems to me that it is not a question between steam and electricity as to the speed at which we shall be able to travel, but simply the question of construction of tracks, and that we can obtain a much higher speed with steam if we only construct tracks according to his ideas.

E. C. FERGUSON: From the standpoint of a practical electrician I can't have very much to say, but there is one thought that struck me when Mr. Degenhardt was discussing the merits of this case. It was with reference to the annihilation of time, and the disposition of the public to pay for that annihilation. I do not think he took into consideration what they are doing in Michigan, where they are making all the railroads come down to two cents a mile, and the Farmers' Alliance is stepping into the breach, and limiting the price of the annihilation of time. In the matter of economy I think this will knock his theory in the head. But considering from another practical standpoint the use of electricity in the place of the steam engine, not from the position of an electrical engineer but as a layman, I would say that you have got to take the railroad as it now is. If you undertake to apply electrical appliances for the pulling of trains, you must have something that has a broader scope as far as applicability is concerned, than any electrical machine I have yet seen. To apply a storage battery to a locomotive, to my mind is not feasible, for the simple reason that it has weight enough on it without carrying any storage batteries. An engine, I claim, has to perform a service along the line of the road that no electrical appliance, that I know anything about, can perform. When you come to apply electricity to a railroad you must have something that can not only run a freight train; but run a passenger car; it must run a construction train, it must do all sorts of work, and any common laborer must be able to handle it. You must have the enormous weight on the locomotive when you have a heavy train on a heavy grade, and there is nothing about the construction of electrical machinery which will give you one-tenth part of the necessary weight. If you fill the locomotive with jars holding electricity—storage batteries, more properly speaking—I believe you could not then get the weight. If you did get the weight you would have such a bulk of machinery that your engine would probably be as large as two of the present engines.

MR. ARNOLD: Mr. Ferguson states that he does not think it possible to get the necessary weight in the space that is occupied by the locomotive. This I must take exception to, and I think any one else will, who knows what the weight of an ordinary locomotive is, and who also knows the weight of storage batteries, and electrical machinery. A locomotive is nothing but iron and steel, a combination of metals, water and coal. A storage battery is composed of lead, and a solution of water and sulphuric acid, and would be, I think, practically the same weight as the water in the boiler. Locomotives weigh from 50 to 70 tons; some higher than that, but a 65 ton engine is a very heavy engine. I have made no calculation on this problem but I believe you could get the same amount of weight on the same wheel base, with the storage battery as you can with the locomotive. That is why I insist upon the storage battery system for heavy work. You must have something to give weight for adhesion, and I see no other way to make your locomotive unite weight with power, as it has to do the work of switching, and it must be entirely independent from any external source of power for at least a short time. While I cannot prove my statement now, I think it can be substantiated, that the storage battery system will prove fully equal to the requirements of such cases.

MR. SPERRY: In locomotives the pressure of the drivers on the rail enables the steam to produce a pull on the draw bar. I agree with the last speaker that there will probably be no difficulty encountered in getting the necessary weight on the drivers of the electric locomotive. But one difficulty will undoubtedly be experienced in obtaining the necessary initial torque. You understand that the locomotives used in the suburban service, for instance on lines running out of this city, have very much larger cylinders and boilers, in comparison with the weight and wheel base, and the general weight of the locomotive, than even the mountain locomotives. The cylinders are enormous on our Illinois Central suburban engines. And the valves are set, when the reversing lever is either in one or the other extreme position, so as to take steam at full boiler pressure, during nearly the entire length of the stroke. They carry anywhere from 110 to 150 pounds of steam, generally about 135 pounds; and when you consider this with the area of the cylinder in connection with the stroke and diameter of the drivers, and also remember that with 18 to 24 tons on the drivers there is no slipping of the drivers on a sanded track, we are brought to realize that the torque is something which it is almost impossible to match by any electrical machine. For instance, if you investigate the designs that were recently brought forward in connection with the rapid transit schemes in Baltimore with reference to the initial torque, and with reference to the current required to produce such a torque, you are met immediately with the fact that the conductors upon those motors are entirely inadequate to convey the current that is necessary to produce any such torque. You see also that the magnetic field is totally inadequate to produce the magnetic flux that is necessary to produce the torque during the time of the acceleration of the train. In figuring on the suburban service you will find they divide the time up into three parts—four parts perhaps. We will say 17 seconds is the average stop at a station. Then they figure the number of minutes and seconds during which the train has to be accelerated, and then the number of foot tons that are applied to the train to get it under motion, then the number of minutes between stations that the train is being pulled at a uniform rate of speed, during which time steam is used very much more economically than it is at any other time. And fourth, they figure the time used in getting down to a stop again. To lessen the second and fourth division they have resorted to every device that the science of engineering can furnish. They have tried compounding their locomotives to secure additional economy over the ordinary practice, but so far as I now know, it has been found impracticable so to do, from the very fact that the second element of time which I named cannot be met within the amount of time required to accelerate the train. The draft on any limited supply of energy, as a storage battery, that would be made in ordinary practice on the Manhattan road, or our suburban service here, would necessitate having such a number of cells that the battery would certainly be found to give all the weight on the wheel base that is necessary; and as the second speaker preceding me said, there would be required a number of cars, or a longer car undoubtedly to contain those cells. But I deem railroading with the storage battery system, as it now stands, as perfectly impracticable. I think the only way the problem could be worked on with any degree of success would be with direct and positive connection maintained with the source of power, and while this beautiful scheme of a combination of the two might be used to influence the mind of some people that are skeptical with reference to it, I think that practically its use will be found to cease at that point.

MR. PERRY: In answer to the remark of Mr. Ferguson with reference to our inability to work a switching engine by electricity or to haul heavy loads over mountains, and do miscellaneous service, I would say that if you give us an electric locomotive as powerful as the steam locomotive, we can do with the electric locomotive just what we can do with a steam engine, because there will be no difficulty in having conductors from which to draw current in the vicinity of the track.

Now one point in regard to the initial torque. We must bear in mind that a locomotive is two engines, supplied, of course, from one boiler; but nevertheless, two separate and distinct engines. Each side has its cylinder, piston, cross-head, guides, links, etc., and if we examine the relation of one side to the other, we will find that the crank pins are set at a quarter. Remembering this, we can see that we never get the maximum effect from the cylinders. If the crank pins were directly opposite on both sides, there would be one position in the stroke at which you would have the maximum effect, and that would be greater than any effect you can obtain with the present arrangement. Now the electric locomotive would, in all probability, have a huge armature, and the torque on that armature would be the same at every point throughout an entire revolution. In other words, we would always have the maximum effect. I think that is one point in favor of the electric motor.

E. C. FERGUSON: I want to say in addition to what Mr. Perry has said, if we use an overhead system you cannot utilize an electric engine in the miscellaneous service of a railroad. It is the extreme circumstances which the electric engine must meet. The switch yard of the C. B. & Q. R. R., near LaVerne, comes to my mind. That is perhaps as fine a yard as has been laid out in this country. In such a yard as this I think if you used the trolley system the overhead work would have to be so intricate that it would not be possible to keep the wires charged at all times, so that an engine could run in here, and out there, have a dozen of them working in the yard. Then it seems to me that the expense of keeping up the system would be enormous.

MR. NICHOLS: I beg to differ with the last speaker; I am comparatively a late railroad man. I was connected with the railroad that he mentioned, and at one time dealt with the problem of doing the entire switching in the Hawthorne yard, which was the yard he spoke of, by electricity. I think such a problem is one in which the electric motor will succeed. I think it will succeed, and especially in such a yard as the one he mentioned. The switching of cars in freight yards is work to which I think the electric motor will first be applied in railroading. I do not think that in running other trains it will be possible to convince the railroad manager that the electric motor is a desirable factor, simply because in using anything but the secondary or storage battery he places himself in the power of competitors, or what is sometimes worse than competitors, viz., strikers. These latter the railroads have to deal with occasionally.

The switching work at the Hawthorne yard is done by inclined planes, and the cars are "kicked," as the railroad man says. They are not pulled or hauled, but they are pushed, and only pushed for a very short distance. The thought of applying electricity was suggested by my watching the switching in this yard. Now the switch engine which does the most efficient work, is a very heavy one indeed. Not only that, but being so large and consuming so much steam, it requires a considerable water capacity, as well as a place for coal. This engine then is carrying around with it an additional weight, which does not add an iota to the tractive power. If all this can be supplanted by the electric motor which would possess nothing but the machinery to produce results, economy would follow. The electric motor and the trolley system, assuming that that would be the practical system for a switch yard, would have to cover only a very limited space. The Hawthorne yard, if I remember rightly, has a storage capacity for 30,000 cars. It is the largest yard in this western country. It is built on the same plan that all the large yards in the country are now being constructed.

When switching in this yard a train is thrown in on one track, and left there by the main line engine. The switch engine goes on a parallel track; these two tracks are at the top of a grade, and by pushing with a pole at the end of a car starts a section—it may not be more than one car—down that inclined plane, giving it a sufficient "kick" to carry it to the most distant point, where it is switched by men guided by hieroglyphics on the advancing end of the car. You see that this switching engine does all this miscellaneous work in the yard, and it rarely covers more than a couple hundred feet of track. You would require consequently a very short overhead wire to do the work in such a yard as the Hawthorne yard. The cars are distributed in these different tracks, and the engines that take the cars simply back up at the further end of the tracks, and draw the train away.

I thought at first that there was some disposition to consider the railroad man as a rather bigoted, short-sighted, narrow-minded fellow, who had his ideas set in a certain line, and did not propose to have them changed; that he was not a man that could be convinced by any progressive electrician. My experience with them has led me to believe that the railroad man is more than willing to be convinced.

The progressive railroad man feels the deepest interest in the subject of electricity, and especially in that system which would apply to regular railroad work. I have heard of the tests that were made on the New York elevated with an electric motor discussed more by railroad men than I have by electricians, and I know that at the time those tests were made the railroad men were intensely interested in them, and I know that when the results of those tests were given out as rather detrimental to the adoption of the electric motor in railroad work, there was a great deal of disappointment among progressive railroad men. They were in hopes that the results would be so enormously in favor of the adoption of an electric motor that it would be only a question of a very few years before the steam locomotive, a very economical machine, would be supplanted by the electric motor. The railroad man is in a rather peculiar position. It may be that if an electrician will come forward so great in his enthusiasm and so sure of the results which he can obtain in this electric motor work that he will build his electrical railway, and more than half present it to the manager of some railroad, then doubtless this railroad would accept it, convinced of its economy. But the railroad itself does not propose to start out on any chimerical idea that some enthusiastic electrician may advance and stand a heavy expense, without being sure of securing wonderful results.

I do not think electricians will find any difficulty in convincing managers, if they can substantiate their claims of the economy of electric motors.

F. B. BADT: I would like to say a word about switch engines. I noticed that in England the railroad people do not like to have engines run into their nice stations; they do not like the idea of having the engines smoke in them. They generally have switch engines outside the stations to push the trains in, and the main line locomotive has to stay out. I also notice that in some instances they use horses in the place of switching engines. They do all the switching inside the stations by means of horses. I also know when the new station was built here in Chicago, the Grand Central, that this problem came up, and that the gentlemen mostly interested in that station very seriously objected to having engines run into it. The engineer of that railroad, Mr. Johnson, propounded to me the question, "How can we fix it? Can we have some stationary motors, and have the trains hauled in in that way, or can't we have a little trolley system, and one or two electric locomotives and do the switching?" Therefore, I think that the gentleman is right in saying that switching will probably be the first thing that will be done by electric locomotives, for the reasons that he gave, and for the additional reason of keeping smoke out of the station.

J. J. NATE: There is a question in this problem that strikes a timid individual, and that is whether we want to ride through the country at the rate of 200 miles an hour or not. I don't think I want to, and I don't think there are many who do. One thing is quite certain, they don't want to do it with the present standard of railway construction. It is not safe, and will not be for a great many years. The switching part of the work is desirable if it could be handled by the means of electricity. I must add my opinion that I believe that this branch will be the first to be taken up and successfully developed. I do not think that we are very near the successful attainment of electric locomotion as applied to railroad transportation, and it will probably be some years before we are.

W. W. NICHOLS: I think we have something right near our home which will bear upon the question; that is, this South Side Rapid Transit road. When the motive power for this line was discussed, I believe a number of engineers were brought into the discussion, and the management was perfectly willing to adopt the motive power which they should decide upon as being the most economical and the most efficient for the requirements of the service. After considerable study and considerable discussion by a great number of bright minds, they decided upon the steam engine, and not only upon the steam engine, but upon the compound steam engine, as the best steam engine that could be used in the service.

E. E. KELLER: As I look at the problem, the station-along-the-route system would be the solution of the problem, if there is any solution, for the simple reason that a large station can be built so as to produce power economically. I think that the electric motor, as applied to street cars to day, is certainly more economical than any other motor that could be used for the same work. I remember one time at Ogden, Utah, they had a very steep grade, with a dummy engine drawing a single car; this was only about three months ago. The dummy would start up the grade, and get stuck about half way; then it would back up and try it again. They were equipping the road for electric power at the time, and had one electric car running. That electric car came along behind this train, and shoved it up the grade. It was 30 horse power equipment. There was nothing special in the motor car, but the weight of the motor itself, so there was no extra weight on the motor to give it adhesion, but still the motor shoved the engine and the car ahead of it. It looks to me that a station built especially for generating current to supply a conductor that may extend 20 or 30 miles in each direction, could be built so as to generate power very much more economically than a locomotive could; and the machinery

will certainly be very much more simple. I do not suppose that the problem will be solved within the next few yeas.

MR. PERRY: I want to say a word in reply to Mr. Nichols. Perhaps I was a little severe in my remarks relative to railroad men. All I wanted to bring cut was that they were a conservative class, and on this account we would have to talk plain everyday facts to them before we began to make any progress, also that it is a good thing for us to know just what difficulties we have to overcome, and look them squarely in the face.

Electricity in the Production of Aluminum.

The paper on "Electricity in the Production of Aluminum," read by A. S. Brown before the American Institute of Electrical Engineers, and presented in the WESTERN ELECTRICIAN, May 2d and 9th, was followed by the following discussion:

PROF. FRANCIS B. CROCKER: There are two points in connection with aluminum which I wish to consider particularly. The first relates to the properties and the second to the production of aluminum I think that Mr. Brown spoke very truly in regard to the exaggerated ideas of the advantages of aluminum, but I do not think that he went quite far enough. The popular idea of aluminum is that all of the good properties of its alloys are attributed to aluminum itself. It is like one individual having all the good qualities of all his relatives attributed to him personally. This is, of course, an absurd fallacy. Nevertheless, it is one that is made in every newspaper article on the subject, and I am sorry to say that it is frequently made in technical journals. The most common mistake of the kind is to attribute to aluminum itself the tensile strength of aluminum bronze, which exceeds that of wrought iron and is about as high as good specimens of steel. It is really one of the most tenacious metals known, but its composition is about nine parts of copper to one part of aluminum; yet its tensile strength is almost invariably attributed to pure aluminum, having a specific gravity of 2.6, which is only one-third that of iron. They take the low specific gravity of pure aluminum and the high tensile strength of aluminum-bronze. As a matter of fact, the specific gravity of aluminum bronze is higher than that of iron. Therefore we do not have lightness combined with high tensile strength. Turning again to aluminum itself, its tensile strength is about 26,000 pounds per square inch; in other words, about one-third that of iron. This just balances the difference in specific gravity, but still leaves the advantage in favor of iron, because one-third of the volume has the same strength and the same weight as a rod of aluminum. Now the same exaggeration is applied to its other qualifications; for example, its chemical properties. Aluminum bronze is remarkably free from tarnishing. A bright surface of aluminum bronze may be exposed to the atmosphere for several months and retain its polish. That property is attributed to aluminum itself. Aluminum, as Mr. Brown said, is not particularly liable to corrosion, but if it is subjected to salt water or alkaline water, or even ordinary moist air, it does tarnish and oxidize rapidly. Salt water is quite hurtful to it. Therefore, freedom from oxidation is another property that is wrongly attributed to it; and the objection to all this is that it gives a very wrong impression in regard to what would otherwise be a good and legitimate object of admiration. I am not prejudiced against the metal aluminum and would be very glad to see it used extensively, but I do not think its extensive use will be hastened—in fact, I feel quite sure it will be retarded—by absurd exaggerations of its good qualities, because when people do come to use it they will be greatly disappointed. This common idea, for example, that it has 100.000 pounds tensile strength per square inch, and about one-third the specific gravity of iron would lead any one into serious difficulties. There are certain things that seem to have a glamour about them—a word which Mr. Brown uses, and which expresses the fact perfectly. Storage batteries and aluminum seem to be particularly favored by the public, and it has occurred to me that a combination of aluminum and storage battery—that is an aluminum storage battery—would be simply irresistible.

Now, taking *seriatim* the actual properties of the metal, and considering them as mechanical, chemical and electrical, we have under the mechanical head a specific gravity of about 2.6, which is almost exactly one-third that of iron, and its tensile strength is 27,800 pounds, according to Mr. Brown, which is again almost exactly one-third of ordinary wrought iron. Therefore, iron and aluminum have equal strength, weight for weight but iron has, as I have said, the great advantage of one-third of the bulk for the same strength and weight. Furthermore, any metal which "can be easily cut with a knife" is not particularly good for structural purposes as a metal. In my opinion it is too soft altogether. It is very much such a metal as zinc or tin. In fact one can hardly tell the difference except by the weight, in filing or cutting it; and certainly tin or zinc are seldom used for structural purposes, and I do not think they would be, even if they were very much lighter than they are.

Taking up the chemical properties—I have already alluded to the ease of of oxidizing, which, as I say, is not excessive, but still about equal to other metal, such as tin, zinc and iron. It is easily, in fact, eagerly, attacked by acids. It is not much affected by sulphur or sulphureted hydrogen, which is a great advantage. It is very freely dissolved by alkalies, whereas most other common metals are not. In an ordinary alkaline solution, aluminum is dissolved, as most metals are, in acids, with the evolution of hydrogen. This is quite a serious disadvantage for a common metal, which is liable, for example, to have soap used upon it We do not expect metals to be attacked by alkalies.

As to the electrical properties—of course conductivity is about the only one. The electrical conductivity is about twice that of copper of equal weight, and is about half that of copper of equal volume Where it is important to have a light wire, and the size is not to be considered, you can use an aluminum wire, because you get an advantage of 2 to 1 in weight. But when you consider size, for instance, a wire which has to be covered with insulating material that is expensive, then you would have a disadvantage. The figures happen to be very simple in all these cases.

In regard to the manufacture of the metal, that, I think, is an electrical monopoly, for the simple reason that I do not think anything else can successfully compete with electricity in the production of a metal the chemical affinities of which are as high as those of aluminum. Aluminum has great chemical affinities, ranking about half way between the ordinary metals and metals like sodium and potassium. These chemical affinities exhibit themselves when it is attempted to separate aluminum from chlorine or oxygen, for example. The ordinary smelting process does not seem to have ever been successful in the reduction of aluminum. So far as I know aluminum has never been successfully reduced as iron or other ordinary metals are reduced by merely smelting in a furnace with coal. The nearest approach to this is smelting in presence of carbon, but with a very high temperature obtained by the electric current, higher than can be obtained by smelting. Therefore, even if we employ the process of smelting, we still have to employ electricity. In any electrolytic reduction of the metal, of course, we have to employ electricity. Such a process seems to be a very simple and effective method, *i. e.*, the plain electrolysis of some compound of aluminum, the electrolyte being in a fused state between two electrodes. Now the fused state is necessary instead of the ordinary aqueous solution, because if you attempt to separate aluminum in an aqueous solution you will get hydrogen instead of aluminum. In other words, water is more easily decomposible than the aluminum compound.

Then we have, as the only other likely substitute for these two electrical processes, the ordinary chemical method of reducing, by means of metallic sodium, some compound such as the chloride or double chloride of aluminum and sodium. But even then I think we had better make our sodium by electricity; so it would still be an electrical process. So far as I can see, and experience in the past few years seems to corroborate this view, electricity is the only commercial means of producing aluminum at the present price. In the old days, when the chemical process was used, aluminum was $12 or $15 a pound. Now it is about $1, and I doubt if any chemical process could compete on this basis. Therefore, the reduction of aluminum seems to belong to electrical science, and it is certainly a very interesting and important application of electricity, and is, I think, destined to be perfectly successful.

F. L. POPE: I have always felt a good deal of interest in aluminum as a metal, ever since the time, many years ago, when the now venerable Moses G. Farmer said to me: "There is seven dollars' worth of aluminum in every brick, if we could only get it out, but," he continued, reflectively, "I suppose if we should finally get it out it would no longer be worth seven dollars." So it was not without gratification that a little over two years ago I accepted a commission in behalf of the parties who subsequently established the plant at Boonton, of which Mr. Brown has told us this evening, to visit the works where the Heroult process was then being carried on at the Falls of the Rhine in Switzerland, and make a careful investigation of it. One thing that struck me very forcibly was the small amount of manual labor required in the works in proportion to the value of the product. They were turning out at the Rhine Falls a good many hundred pounds a day of aluminum bronze, and employed only six men, five of whom were ordinary day laborers. I was also particularly impressed with the admirable performance of the dynamos used in Switzerland, which are precisely the same as the one at Boonton, which Mr. Brown described. There were two of them coupled together, and to a vertical turbine, and rated at 150 horse power each—a very moderate rating I should say. I saw the ammeter, on one occasion when I was watching it, indicate 27,000 amperes. The current heated the loop of the conductor which surrounded the ammeter, which was a copper bar three and a half inches square, yet very little sparking was perceptible at the brushes of the dynamo. The machine gave a sort of a grunt when this great load was thrown on, but that was about all the effect that was observable.

ALBERT STETSON: The trouble with aluminum is not in the making of it, but in the handling of the metal after it is made. There are only very few people in all the world who know how to handle the pure metal and cast it, and even those people, with all their experience, very often get poor castings, and so their work becomes very expensive. Good work can be done by teaching the manufacturers of the country what to do with the material after they get it.

Verbiage in Patent Specifications.

All who have exhausted their patience in wading through tediously worded patent specifications will appreciate the following from the *Engineer* of New York: "Sometimes we laugh at lawyers and their legal phrases, their aforesaids, whereases, etc., etc., but we might with more propriety put a lance in rest for our friend the patent specification writer. He is the tedious, turgid, too effulgent parent of sonorous phrases, which mean too much, or mean nothing, according to their connection. You will never get him to tell the truth in plain words; he abhors such a practice. If he has to say that there is a hole through a spool he says: 'It is given a longitudinal perforation' This is much more secure in a patent than the word 'hole,' for the latter might be evaded in some way, but no one could possibly frustrate a longitudinal perforation. The patent specification writer will not say a casting is made in one piece; he will say it is 'integral,' and if he has to say that one piece is near another piece he will not state that fact as we have, but he will say that it is 'in adjacency to it;' he will also assert that one chamber circumscribes another in preference to saying that it surrounds it, and he will, in other ways, so befog and mask what he should say, that he succeeds in producing a claim that may mean any one of half a dozen readings, when the whole facts could be told in simple language that admits of no misinterpretation whatever."

Some Possible Modifications in the Methods of Protecting Buildings from Lightning.

At the conclusion of the paper read by N. D. C. Hodges before the American Institute of Electrical Engineers on some possible modifications in the methods of protecting buildings from lightning, and presented in the WESTERN ELECTRICIAN, May 20th, the following discussion took place:

EDWARD P. THOMPSON: Electricity occurs in thunder-storms, and the best thing to do is to get rid of it. One way is by conducting it away with sufficient rapidity by means of a conductor of very large surface. As I understand the speaker, he proposes to provide a system whereby the electrical energy is not conducted away, but converted into heat. As to practical equipment, some incombustible non-conductor, such as asbestos, should be placed between the thin metallic strip and the structure to be protected, or else the melted metal may set fire to the building.

WM. E. GEYER: It seems to me that the occurrence quoted from Franklin tends to show that the ordinary theory of the lightning rod is essentially true. The bell-wire, so far as it went in the occurrence described, was a lightning-rod, and protected the building so far as that lightning-rod went. It was not heavy enough to carry the current and it was for that reason dissipated, so that the dissipation was simply an accident. The mere dissipation, however, did not save that part of the building where the wire stopped and there was no good conductor; the building was without any lightning-rod and was more damaged than where it had even a small rod.

TOWNSEND WOLCOTT: Professor Lodge's theory of the Leyden jar discharge is that it is oscillatory under ordinary conditions, that is, where the coatings are connected with a good conductor. Now, if they are connected with a bad conductor, such as a wet string, Professor Lodge says that the discharge may be only in one direction.

As to the point which Dr. Geyer just mentioned, that Mr. Hodges' experiments support the ordinary theory of the lightning-rod—I think his reasoning does, to some extent too, in regard to getting rid of the energy on the central core. Take the ordinary lightning-rod—the way it is intended to work is rather to prevent a disruptive discharge than it is to take care of one that has already occurred. We desire to equalize the difference of potential by drawing off the charge from the cloud before it gets to a dangerous limit. If we can do that we do not have any disruptive discharge at all. It is just like a Brush discharge such as you get from a conductor with points on an electric machine. I do not think that any one system of lightning-rods has proved successful. Sometimes a lightning-rod will take care of several discharges in a single storm, and that seems to be something which Mr. Hodges' lightning rod would not do; because, after it had been dissipated by one discharge, I do not think, even if it could be put up in a few moments, that anybody would care to be monkeying around a conductor when there was lightning. Mr. Hodges having asked us to clear our minds of the idea of conducting electricity, seems to go further than most of the modern theorists on electricity. I think Mr. Hodges, even if he does not use the idea of electricity, will admit that we want to make a metallic way entirely down to the earth. The case is somewhat analogous to the Leyden jar. That is, to conductors separated by a dielectric. Now, we want to bridge over the whole space of the dielectric, whether you use the idea of conductivity or not. So I don't think it makes much difference whether you use his dissipatable lightning rod or a stout one.

MR. HODGES: In order to make the paper of some length, I gave some theory. I know the books state that the ship "Jupiter" was saved from destruction in spite of her lightning rod going to pieces. But take the fact without going to the books at all. I want to get a case where the conductor has gone to pieces, and where the ship has not been saved. I have not found such a case. Can you cite a case where the conductor has gone to pieces, and there has been any destruction to the building between practically two horizontal planes passing through the upper and lower ends of that dissipated conductor? You will find that there is damage above and damage below, very likely.

MR. WOLCOTT: Although I do not question that conductors work as Mr. Hodges described, we also find that they work the other way, according to the old theory, in very many instances. It certainly is a matter of record that conductors have sometimes carried off several discharges in the same thunderstorm, which a dissipatable conductor could not do unless you were able to put up a second one in the place immediately after the dissipation of the first.

A MEMBER: The Washington monument is a pretty good lightning arrester. I was shown a few weeks ago by Prof. Owens where lightning had struck and knocked out big chunks of stone from the monument. He seemed to think that lightning followed the path of least electrical resistance, so he put up an additional wire and connected that with the new iron work of the monument, and he says he has not had any trouble since then with stones being knocked out.

CHARLES STEINMETZ By using such an interrupted conductor of small cross-section, that is a comparatively high resistance, you are liable to change the whole nature of the lightning discharge. You change it from an oscillating discharge to a steady and continuous rush of current, from which you must expect quite different effects.

When, for instance, you discharge a condenser by a con-

ductor of very low resistance, you get an oscillating discharge of an extraordinary high frequency. If you increase the resistanee of the conductor the number of oscillations of the discharge decreases; it runs down quicker, until at last you reach a value of resistance where only one wave of discharge current appears, that is, the discharge of the condenser becomes steady.

Now, if we can make a lightning discharge steady, instead of oscillating, then we have first to expect that the electricity traverses the lightning rod only once, slowly increasing in current strength and then decreasing again by going down to the ground; while in an oscillating discharge the current will rush to and fro through the conductor until its energy is consumed by the resistance of the lightning rod, or by electro magnetic radiation and re-radiation from the induced currents produced by the oscillating discharge in neighboring conductors.

Electric Riveting Interference Decision.

The following communication from Elias E. Ries of Baltimore, Md., will be of interest to the readers of the WESTERN ELECTRICIAN:

"Two important decisions have been rendered by the Examiner of Interferences in the United States Patent Office, in which priority of invention of the broad art of electric riveting and also of the apparatus for practicing this art was awarded to Elias E. Ries of Baltimore, the other party to the interference being Prof. Elihu Thomson of Lynn Mass.

"The interferences just decided were two in number, the first being between the patent of Elihu Thomson No. 396,015, dated January 8, 1889, for a method of electric riveting, and an application of Elias E. Ries that was pending in the patent office at the time this patent was granted. The second interference was between a pa'ent to Elias E. Ries, No. 403 374, granted May 14, 1889, and an application of Elihu Thomson filed June 14, 1889, for apparatus for electric riveting.

"As the records of the Patent Office show that Mr. Ries was the first to file his application for letters patent, and that he had two applications showing and claiming the inventions in controversy awaiting official action at the time the Thomson patent was erroneously issued, Thomson was made the junior party in each of the interferences.

"Testimony was taken by both parties, which showed that Mr. Ries was not only the first to file, but also the first to reduce the inventions to practice, and upon these and other facts brought out by the testimony the decisions awarding priority to Mr. Ries were based. The claims involved in these decisions cover broadly and fundamentally the art of riveting by means of electricity and the apparatus necessary for successfully operating the same. The rivets or rivet blanks are heated electrically while in place and are then headed on one or both ends. The invention is applicable to any kind of work, from the smallest and most delicate jewelry to the largest class of girder bridge and boiler riveting, and promises not only to find a very wide range of usefulness before it, but in many cases to revolutionize present methods of construction work in which riveting enters."

Use of Oil in Converters.

To the Editor of the WESTERN ELECTRICIAN:

In your issue of April 18th you publish a letter signed by Prof. Elihu Thomson referring to your article on page 192, concerning the use of oil in high tension transformers.

The tone of the letter would imply that I had encroached on a patent, No. 428,648, issued in May, 1890. The claim of this patent is for the use of oil as a means of conveying the heat from the coils to the outer casing of a transformer, and not pointedly for insulating, as no doubt Prof. Thomson well knew that as far back as 1880 Brooks employed oil for insulating purposes in a mode quite similar to that described in the patent above referred to.

I never claimed to be the first to use oil for insulating, and have stated in my paper read in Frankfort on February 9 1891, and published in the *Elektrotechnische Zeitschrift*, No. 11 of 1891, my opinion that Brooks was the first to advocate and use oil for insulating purposes.

What I claim is that I was the first to perceive and put into practice the idea that by means of oil it was possible to make commercial transformers for very high tensions; this occurred to me in October, 1889, in working out a project for transmission of 30,000 horse power on a distance of sixty miles, and I am not aware that any one has made transformers in this way before that date, nor do I find that the patent No. 428,648 of Prof. Thomson bears upon the fact.

As to any similarity between the forms of the transformers, the only published drawing of the patent that I have seen are not clear enough to distinguish the arrangement, but I may state that transformers of the type shown through Figs. 6, 7 and 8 of your review of the paper were constructed in the Oerlikon Works in November, 1889, and put to work in an installation in the beginning of 1890.

I am, dear sir, most truly yours,

C. E. L. BROWN.

Oerlikon, Switzerland, April 29, 1891.

Franklin Experimental Club.

The Franklin Experimental club of Newark, N. J., held its thirty-first regular meeting at the club laboratory, Tuesday evening, May 5th. Wm. J. Hammer read a paper entitled "The Arc Light." As illustrating the rapid development of that industry the speaker called attention to the fact that while there was exhibited at the Centennial Exposition in Philadelphia in 1876 but a single arc system, the Wallace, now arc lamps are burning everywhere and are numbered by the thousands and hundreds of thousands. Mr. Hammer summed up the problems confronting the arc light men and spoke of the field for invention in alternate current lights. The paper was illustrated by diagrams prepared and mounted for the occasion. F. M. Crane spoke on electric railroads. He compared the three systems which are striving for supremacy in that field—the trolley, the storage and the conduit.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 9 —The intention of the Brooklyn street railway companies to change from horses to electricity has stirred up a great deal of commotion in the city of churches. It is a singular fact, however, that the Brooklyn press, with the exception of one paper, is not opposing an improvement which will be of such vast importance to the city. The most bitter opposition has come from a New York city daily whose argument for the most part has been extremely ludicrous. The staterailroad commission met in Brooklyn last Tuesday to consider the protests of residents against the introduction of the trolley system. Quite a number of persons alleged that it would be noisy, and presented at great length exploded theories relating to the dangerous element which would be introduced into a community by the construction of an overhead system. A representative of the street railway companies met these objections by reading letters from persons residing in towns where electric railways are operated. The writers asserted that electric railways were in every way desirable, that they enhanced the value of property, afforded residents rapid transit, and were by no means dangerous. The hearing was adjourned to June 6th, when the commissioners will meet in Albany.

One of the local papers is responsible for the statement that every large surface road in New York city is contemplating a change in its motive power. Some of them, it is stated, prefer the cable, but the majority incline toward electricity. The latter, it is stated, are looking forward hopefully to the time when they can use storage batteries or some conduit system, as of course the use of overhead wires in the metropolis is deemed out of the question.

The Board of Borough Commissionurs of Asbury Park considered at a meeting this week the reso'ution extending the franchise of the electric railway company fifty years, and permitting it to build a double track bel: line and retain the wooden poles which now support the wires. Some opposition to the grant of these privileges was shown by residents of the city, and the board declined to extend the term of the franchise. The question of wooden poles was deferred. W. H. T.

Minneapolis, Minn.

MINNEAPOLIS, May 9 —The J. R Clark company has recently perfected machinery for the manu'acture of octagonal poles for street railway and electric light use, and a new mill has been built on the line of the Soo railway, having a capacity of 100 poles per day. These poles are made of the best Norway pine, and the machinery has been perfected so that every pole will be given a perfect taper and smooth finish. The butts are left the full size of the timber, and painted with a new preservative paint known as fernoline. The sales agency for these poles has been given to the Coolidge Fuel & Supply company, and 5,000 will be turned out at the earliest possible moment. The J R. Clark company also manufactures for the electrical trade a general line of cross arms, pins, brackets, rosettes, cleats, etc., and has succeeded in building up a fine trade extending over the entire western and northwestern states.

The Coolidge Fuel & Supply company of Minneapolis, which is a contractor and dealer in railway ties, piling, bridge material, hardwood lumber, etc., has taken the general sales agency for the Clark octagonal pole for street railway aud electric light work, and has given an order for 5,000 for immediate delivery. This company has a mill at Downing, Wis , on the Wisconsin Central railway, and has excellent facilities for reaching the trade, which, in connection with the low freight rates given to Minneapolis dealers and manufacturers, will make it possible to supply this pole at a price much below that previously asked. This pole is being largely used by the Minneapolis Electric Street Railway company for its double track line, and, fitted up with a new cross arm that has recently been perfected, and a cast iron guard for the base, it makes an efficient overhead construction. P.

Concord, N. H.

CONCORD, N. H., May 9.—The bill to incorporate the West End Street railway of Concord, N. H., occasioned quite a fight in the New Hampshire legislature during the last session. The Main street system has been contemplating an extension of its line to the western part of the city, but these incorporators evidently intended to make it pay for the franchise which they intended to secure, and which the old company claimed was already granted. An agreement was finally made whereby the old road will so lay its tracks as to accommodate the West end people. The proposed route is not a mile in length, and it is hardly probable that an independent road could exist on the patronage.

The main street road has purchased a new engine of 100-horse power, and several Stephenson cars and laid new tracks on the main line.

This city has two of the best undeveloped water powers in the country within a mile or two of the center of business, estimated at 10,000-horse power. This property is patiently waiting for some one who has capital and enterprise to develop it. This water power and that available at several other points on the Merrimack make it a good place to show the superiority of electricity over steam for railroad use, as the Concord & Montreal railroad runs close to the river near by its entire length, and above Merrimack the mountain streams would furnish abundant power. It is said the Concord board of trade is contemplating developing the power here for electrical distribution.

The session of the New Hampshire legislature just ended passed bills incorporating and amending the following electric road, light, and power companies at Manchester, Nashua, Exeter, New Boston, Hoopsett, Derry, Concord, Newmarket, South Newmarket, Hampton, Littleton and Lebanon. H.

Cincinnati, O.

CINCINNATI, O., May 9.—The Electric Supply & Contracting company of this city has just sold to the Cincinnati Electric Light company $17,500 worth of motors of various sizes from ⅛ horse power to 25 horse power inclusive. The Electric Supply & Contracting company represents the C. & C. Motor & Manufacturing company of New York. It has also contracted to equip one of the largest steamers in the Ohio and Mississippi trade with an incandescent plant and arc search lights

The Edison General Electric company is pushing operations on its new station. It is sinking six artesian wells, and expects to use the water thus obtained for surface condensers with which the station will be equipped.

The South Covington and Cincinnati Electric Railway company has just installed additional machinery on its plant located in Covington, Ky., and will have its Newport extension in operation within a few days.

The Queen City Electric company has sold one 600 16 candle power incandescent generator to the St. Clair hotel of this city, also one 650 16-candle power incandescent machine to the Palace hotel.

The Covington, Ky., city council has passed an ordinance to light the city by electricity, and will advertise for bids at once.

The Western Electric company of Chicago, through its local representative, the Standard Electric company, has been awarded the contract for furnishing labor and materials for wiring the new city buildings now nearing completion. The contract price is $10,519,28. The contract has not yet been let for the generators, engines and boilers.

The rumor to the effect that the Queen City Electric company has been bought out by the Thomson-Houston company, has proved to be without foundation. The Queen City company is doing a good business both in manufacturing and lighting.

In spite of the numerous injunctions granted in favor of the Cincinnati & Surburban Telegraph company against the Main Street Electric Railway company, the latter is pushing ahead with its new additions and extensions, with the utmost confidence of eventually gaining the suit. G.

PERSONAL.

Harry I. Skilton of New York City was in Chicago last week.

C. H. Mortimer, publisher of the *Canadian Electrical News*, was a visitor at Chicago last week.

Alex. Lewis, representing the Thomson-Houston company at Cincinnati, was in Chicago last week.

Paul W. Bossart is representing the Short Electric railway company of Cleveland in the western states.

S. D. Greene of the Edison General Electric company, has accepted the position of consulting electrician to the Burton Electric company.

R. C. Carhart, formerly of the Westinghouse company has accepted a position with the Short company, and will give his attention to eastern business.

C. G. Ferguson, formerly with *Electric Power*, has succeeded E. H. Chapin on the *Journal of Railway Appliances*. Mr. Chapin is now devoting all his time to the *Street Railway Journal*.

NEW INCORPORATIONS.

Salem City Railway company, Salem, Ore.; capital stock, $60,000; to operate an electric street railway.

American Vibratory Force Telephone company, Seattle, Wash; capital stock, $1,000,000; to manufacture telephones.

Rogers Park Light, Heat & Power company, Rogers Park, Ill.; capital stock, $75,000; to supply gas and electricity for light, heat and power.

Calcutt Electric Elevator company, Seattle, Wash.; capital stock, $300,000; to manufacture and sell the Calcutt spiral screw electric safety elevator.

Waterford Electric Light and Power company, Waterford, N. Y.; capital stock, $30,000; to furnish electric light and power to public and private dwellings.

Colfax Electric Railway company, Denver, Colo.; capital stock, $50,000; to build an electric street railway in the city of Denver, Colo.; length, three miles with branches.

Stockton Electric Light & Power company, Stockton, N. J.; capital stock, $25,000; to furnish and provide electric light, together with power for machinery for manufacturing purposes.

Clayton Water, Light & Power company, Clayton, Del.; capital stock, $50,000; manufacturing, generating and supplying heat, light and power.

Bostonian Electric Belt company, Chicago, Ill; capital stock, $50,000; manufacture and sell electrical appliances for medical application of electricity, buy, rent or sell patents as may be necessary.

Wilmington Light, Heat & Power company, Wilmington, Del.; capital stock, $50,000; manufacturing, generating and creating and supplying light, heat and power by steam, water or electricity, etc.

St. Louis Electric Railway & Power company, St. Louis, Mo.; capital stock, $50,000; to construct, maintain and operate an electric elevated or surface railroad along Manchester and other roads in St. Louis city and county.

Eureka Springs Electric Light & Street Railway company, Eureka Springs, Ark.; capital stock, $30,000; to construct and own a system of street railways at Eureka Springs, and to own and operate electric light plants and steam power appliances.

ELECTRIC LIGHTING.

The Bertha, Va., Zinc company contemplates putting in an electric light plant.

J. H. Irwin will establish an electric light plant at Round Bay, near Baltimore.

Efforts are being made to secure the erection of an electric light plant in Prescott, Ark.

Far off Bombay has an idea of introducing modern improvements, and there is talk of lighting the city by electricity.

At Georgetown, Colo., the electric light company is erecting a power house. It will be operated by water power.

The Cotton Shoals Electric Light & Power company of Graniteville, S. C., has applied for a charter to erect an electric plant.

The work of lighting the village of Venice, Ill., with electricity has been commenced, and contracts for the required plant have been let.

The Edinburg Coal Mining company is supplying the city of Edinburg, Ill., with incandescent lights. The Thomson-Houston company's system is used.

It is said that the new *Boston Post* building is the first building in New England in which electricity is entirely depended upon for illumination. There is not a gas-pipe in the building.

Lemars, Ia., has decided by a vote of 414 to 148 against bonding the city for $20,000 for the erection of an electric light plant. The people want an electric plant, and a franchise will probably be granted to a private company.

The Light & Power compay of San Jose, Cal., has decided to issue bonds to the amount of $60,000. The object of the issue is to improve the works and enlarge the capacity of gas production and of electric light and power.

J. F. Johnson has started an electric light plant in the state penitentiary at Huntsville, Tex. The capacity of the plant is 400 lights Two compound United States dynamos, driven by a Corliss engine of 50 indicated horse power, comprise the installation.

The Carpenter Electric Light & Power company of Catletsburg, Ky., announces that it will at once put in an addition to its steam plant of 100 to 150 horse power capacity and may substitute for its direct current incandescent an alternating current system.

The Peninsular Electric Light & Power company of Newport News, Va., has been organized with E. C. Hillyer, president; L. P. Stearns, vice-president, and W. W. Archibald, secretary, to furnish arc and incandescent lights, also power for motors; capital stock, $40,000. The Newport News Electric company has been consolidated with this company.

Electric lighting is making steady progress in Vienna. The International Electricity company now supplies 15,000 lamps of 16 normal candle power each from its central station, and it seems probable that this will be enlarged so as to supply 20,000 lamps next year. The central station belonging to this company at Fiume, which is used for the distribution of power by an alternating current, is also to be extended. Two motors of 12 horse power each are being erected, and the elevators are being provided with electric light.

The Co-operative Wholesale society's flour mill at Dunston-on-Tyne has been lighted throughout by electricity. This installation is the largest in a flour mill in the United Kingdom, and is very complete in its details, the total installation consisting of about 600 16 candle power incandescent lamps. The generating plant consists of three vertical engines. The two larger engines drive two of Scott & Mountain's Tyne compound-wound self-regulating dynamos, each constructed to run, when lightly loaded, 400 16 candle power incandescent lamps, but capable of working up to 600 incandescent lamps in case of emergency.

Opposition to overhead electric light wires is developing in England. A London paper says: "There will be many a contest between local authorities or gas companies and electric lighting ventures before the last are firmly established. The presence of overhead wires in country places and towns which hitherto have not had their sky dimmed by bundles of metal is certain to cause friction. A case has already come from Fareham, Hampshire, in which the local board and the Fareham Electric Light company sought to restrain one Smith from removing, cutting or interfering with the electric wires and apparatus running past his house. The defendant objected to the unsightly poles and wires and—partly on the ground that they might interfere with his building operations, and partly on the ground that he was entitled to the subsoil of the adjoining half of the highway—he threatened to treat the company as trespassers. Justice Chitty has pointed out that, though the owner of land adjoining a highway has a right to the soil of half the road, the Public Health Act of 1875 has vested a highway which is a street in the local board, and that they have a right over the subsoil and the space above sufficient to carry out their statutory works and improvements. As the defendant could not show damage to his proprietary rights, or if he could they might well be the subject of compensation, his lordship granted the injunction."

ELECTRIC RAILWAYS.

An electric line is to be opened between Dunkirk and Fredonia, N. Y.

The work on the Denver & Suburban street railway is being pushed rapidly.

It is proposed to unite Burnt Mills and Brookeville, Md., by an electric railroad.

Electric cars have been placed on the Sophia street and Monroe avenue lines in Rochester, N. Y.

The Edison General Electric company will equip the Citizens' street railway at Memphis, Tenn.

The Bay Ridge, Md., electric railroad will probably be extended to Annapolis, a distance of about five miles.

An electric railroad will probably be built this summer from Cloquet, Mich., to the slate quarries near that town.

Contracts for the transformation of the street car lines of Birmingham, Ala., for operation by electric power, have been awarded.

The Helena, Mont., Electric Railway company has applied to the city council for the privilege of restoring ten cent fares, claiming that it can make no money at the five cent rate.

The Short Electric Railway company of Cleveland is completing its first order for its new gearless motor. Several public tests have been made in Cleveland, and satisfactory results have been secured.

An electric railway will soon be built between South Lyon and Leland, Mich., and later it is contemplated to extend the line to Ypsilanti, thus giving a through line, with connections, to Ann Arbor.

A franchise has been granted for an electric road 24 miles in length between Stillwater and St. Paul, Minn. It is intended to have the road in operation for both freight and passenger traffic by October 1st. This will be the first electric railway in Minnesota outside of those used for city passenger traffic.

At a recent meeting of the stockholders of the Union Street Railroad company of Dover, N. H., it was voted to accept the act of the legislature authorizing the road to be consolidated with the Consolidated Light & Power company. The latter company has a large water power plant which not only furnishes power for lighting Dover, Rochester and other cities, but furnishes power for operating the electric cars of the railroad company.

Permission has been granted the Buffalo, N. Y., Street Railroad company by the state railroad commissioners to use the electric single trolley system in place of horses. It is required that the rate of speed shall not exceed that to be definitely fixed by the local authorities of the city of Buffalo; that no car shall be run with less than two men to operate it; that the company shall take all reasonable and proper means to prevent the currents from its wires from interfering with the currents upon the wires of other companies, whether telegraph, telephone, or otherwise, and a guard wire shall be constructed over the trolley wire at a sufficient distance therefrom to prevent broken telegraph or telephone wires from coming in contact with the trolley wire; and that each car shall be provided with safety guards in front of the wheels, coming within an inch of the ground, to prevent persons being run over.

ELECTRIC MOTOR.

The Louisville, Ky., Steam & Electric Motor Power company has completed the erection of its steam and electric power plant. The building is six stories high and 60x224 feet in ground dimensions. The machinery has all been purchased and placed.

French engineers have been trying electric motors for elevating and depressing heavy guns, and for moving them into direction, using a separate motor for each two operations. A considerable saving of time is effected. Three war vessels for Chili, now being built in France, are to be fitted with such motors, to be driven from the electric light circuit.

The Belding Motor & Manufacturing company of Chicago made a general assignment on May 11th. Its liabilities on stock and machinery yet unpaid for will amount to $75,000. About $30,000 is owing to stockholders in the shape of borrowed money. The assets, it is thought, will not much more than clear away the indebtedness. The suspension is said to have been caused by two disastrous fires that ruined the company's stock and shops at Hermosa and by the failure of eastern capitalists to fulfill their promises of financial support. Charles H. Bunker, secretary and treasurer of the company, is assignee. The company was organized three years ago with a capital stock of $100,000 to manufacture electric motors and electric machinery.

ELECTRIC MINING.

The Edinburg, Ill., Coal Mining company claims to have the best equipped mines in the state. Electricity is employed, the Thomson-Houston company's system being used.

The mines of Maryland are pretty thoroughly developed, mining operations having been conducted in that locality for about half a century. Up to the close of the year 1889 the total shipments amounted to over sixty-six million tons. The coal produced is bituminous, and the principal markets have been found at the great manufacturing cities of New England and at the seaboard for the coaling of steamships. During the year 1889 there were in operation thirty-one establishments equipped for the shipping of coal. In addition, reports were received from forty-nine small operators supplying local trade. The total production in 1889 was 2,939,715 short tons, valued at $2,517,474 at the mines, or on an average of 85 6 cents per ton. The product for the census year ending June 30, 1880, was 2,228,917 short tons, valued at $2,585 537 at the mines, or $1.16 per ton. The total number of persons employed in all departments, including superintendents, engineers, mechanics and clerical force, during the census year was 3,734, and the amount of wages paid was $1,730,689. The average number of days worked when collieries were shipping coal was 196. During the calendar year 1888 the output amounted to 3,479,470 short tons. This falling off in the output during 1889 as compared with that of 1888 was due, not so much to a decline in the demand, as to want of transportation facilities, the result of the practical abandonment of the Chesapeake and Ohio canal after the flood of 1884, which partially destroyed it. The anthracite coal fields of Pennsylvania produced 45,544,970 short tons during the year 1889 according to official returns at the census office. The average number of days worked during the year 1889 by all collieries was 194. The suspension of mining, during periods aggregating about one-third of the year, was caused mainly by the inability of the market to absorb a larger product. With the introduction of electrical machinery in these mines the cost of production will be much less than at present, and anthracite coal can be used where the present cost makes it impossible to adopt it. The number of persons employed during the year, including superintendents, engineers and clerical force, was 125,229. The total amount paid in wages to all classes during the year was $39,152,124. The total number of regular establishments or breakers equipped for the preparation and shipment of coal was 342, of which 19 were idle during the year. Besides these there were 49 small diggings and washeries supplying local trade. There were also eighteen new establishments in course of construction.

TELEGRAPH.

The Highland Springs and Squaw Creek Toll Road company will build a telegraph and telephone line in Lake county, Cal.

The St. Louis office of the Western Union Telegraph company was moved from the temporary quarters at 215 Pine street to the handsome new building at 412 and 414 Pine street between 12 and 3 o'clock on the morning of May 10th. The transfer was made under the supervision of L. L. Summers of Chicago. A complete description of the new building has heretofore been given in this paper.

TELEPHONE.

The Bell Telephone company of Rochester, N. Y., is extending its underground service.

Proposals have been made to the British postmaster-general with the idea of establishing telephonic communication between Dublin and Belfast.

It is claimed that Fargo, S. D., has more telephone subscribers in proportion to its population than any other city in the United States. The system is to be rebuilt at once and a new long distance line, built of copper wire, is to be extended to Castleton, 25 miles distant.

According to the press dispatches William Jacques, while riding with his daughter, was attacked by a mob in Flor-

ence, Italy, last week, and severely handled. The young lady was seriously injured. Mr. Jacques is well known in this country through his connection with the Johns Hopkins university and the American Bell Telephone company. His home is Newton, Mass.

In 1890 $160,000 was expended in the work of reconstructing the telephone system of Paris, and it is estimated that $540,000 will be needed for the current year. Of this latter sum $80,000 will be used for the completion of the building in the Rue de Gutenberg, $160,000 will be applied to the work of reconstructing the sewers that are to contain the telephone cables, $120,000 will be devoted to the installation of central station apparatus, and $180,000 will be laid out for cables. The new central exchange will be wired for 6,000 subscribers.

MISCELLANEOUS.

The National Electric Light association has changed its headquarters from 18 Cortlandt street, New York City, to 136 Liberty street.

At the opening of the London naval exhibition on May 1st, the Princess of Wales, after the preliminary exercises, signalized the fact that the exhibition was open to the public by turning a tiny switch in front of a miniature model of the Eddystone lighthouse. This turned on an electric light on the top of the full-size model of the lighthouse in the grounds.

TRADE NEWS.

Manager Harter of the Electrical Construction company announces the removal of the company's factory and offices to 43 and 45 Franklin street, Chicago, where increased manufacturing facilities are available.

George H. Meeker will have charge of the branch office of the New York Insulated Wire company, just opened at 78, 80 & 82, Franklin street, Chicago. Mr. Meeker, is a business man of capability and experience. He will reach Chicago next week. The factory of the company is located at Wallingford, Conn., and the Chicago office will serve as a western outlet.

The Central Electric company has introduced a new portable photometer, which seems to be especially appropriate now, when so much is being said about the efficiency of incandescent lamps. This machine will enable any station superintendent to measure the candle power of his lamps, and thus accurately determine how much each lamp consumes.

The Great Western Electric Supply company, Chicago, reports splendid sale for the new Sun arc lamp. This lamp is manufactured for either arc or incandescent circuits. It is very efficient and economical. The lamp factory of the Great Western Electric Supply company is still taxed to its utmost capacity to furnish the "G. W." lamps. These lamps have now been on the market a sufficient length of time to test them thoroughly, and the duplicate orders which the company is receiving are the best testimonials to the efficiency of the lamp.

A test of the Milliken steel pole for street railway and electric light purposes was recently made by Prof. Carpenter of Cornell university, before the students of that institution. The result was most satisfactory. The pole was one of the standard side poles set in cement, and the strain put upon the top indicated 1,217 pounds before the elastic limit was reached, and 1,667 pounds before the pole gave way. In certifying to the test Prof. Carpenter says that with a minimum amount of material the pole stands the greatest possible strain.

The Electric Merchandise company, Chicago, has been giving considerable attention to foreign business, and hereafter will make a special effort to develop this department. This company, during the last few months, has received a number of orders from tramway companies in foreign countries, and has also received inquiries almost daily regarding the practical working of electric street railways in this country. This has led to a careful consideration of the matter, and after considerable correspondence the company believes that foreign roads are ready to adopt the electric railway system as used in this country, at once, if its advantages are presented in their true light. The company has accordingly dispatched Frank X. Cicott as its representative to Europe, where he will remain two months with a view of interesting street railway men in the American ideas of electric railway construction. Mr. Cicott sailed for Europe on the Cunard steamship "Servia" Saturday, May 9th. He is well acquainted with the tramway companies' officials, and excellent results are anticipated for street railway work from his trip.

BUSINESS.

The Sioux City Engine company has sold a 250 horse power Corliss engine to the Lincoln City Electric Railway company of Lincoln, Neb.

The Fontaine Crossing company, Detroit, announces that it is now in a position to consider electrical construction work of all descriptions. This company manufactures dynamos and a high-speed engine especially adapted for running dynamos.

"K. K." wire is still at the front as a line wire. The Great Western Electric Supply company, agent for this wire in the West, reports very large sales. The company has recently closed several contracts with lighting and railway companies, which will use "K. K." as feed wire.

As the boards of underwriters in some states have condemned the use of any lamp cord that is not fireproof, the Central Electric company of Chicago is offering a cord, which, it is claimed, has an absolutely fireproof covering. The company has already had large sales of this cord.

The Northwestern Electrical Specialty company reports a steadily increasing demand for the Economic incandescent lamp, and heavy sales for last week. Letters are being received from all directions, some reporting the successful introduction of the lamp and others inquiring as to its merits. This would indicate a wide spread interest in the lamp and almost insure its successful introduction to Western buyers and users.

Two compact little pamphlets have just been issued by the Ball Engine company of Erie, Pa., giving a list of users and letters from some of them telling how highly they think of the Ball engines. This engine is built especially to furnish power for dynamos and generators, and its smoothness of running makes it particularly applicable to this use. It is employed in connection with every system, and all users speak of it in the highest terms.

The Mosher Arc Lamp company, 125 Ontario street, Chicago, has sold within the past ten days a large number of its new "Diamond" arc lamps for incandescent circuits, and very satisfactory reports are being received regarding their high candle power and simplicity. The following are some of the large orders filled within the time mentioned: Des Moines, Ia., 33; Midland hotel, Kansas City, 13; Winona, 10; Terre Haute, Ind., 6. These, taken with a large number of single lamps sent out on trial, have made a very active and profitable business for the new company from the beginning.

ELECTRICAL PATENTS.

Issued May 5, 1891.

451,445. Secondary Battery. Thurman H. Aldrich, Cincinnati, O.

451,449. Telegraph Repeater. Albert C. Booth, Cedar Rapids, Ia.

451,491. Electric Railway Truck. Walter H. Knight, Boston, Mass.

451,512. Multiple Signal Transmitter. Bernice J. Noyes, Boston, Mass.

451,514. Electric Brake. Joseph M. Payne, Cressona, Pa.

451, 520. Electric Meter. Edwin W. Rice, Jr., Lynn. Mass.

The invention consists of an expansible rod or bar heated when expanded by the influence of an electric current and a compensating rod or bar attached to the same, but separately mounted or supported, so as not to be heated by conduction or radiation therefrom and adapted to act in opposition to the first when both are heated at the same time.

451,521. Combined Switch and Lightning Arrester. Edwin W. Rice, Jr., Lynn, Mass.

451,540. Secondary Battery. George A. Washburn, Cleveland, O.

451,541. Secondary Battery. George A. Washburn, Cleveland, O.

451,548. Temperature Alarm. Louis Zagelmeyer, West Bay City, Mich.

451,559 Electric Motor. Walter E. Hyer, Newburg, N. Y.

The invention comprises an armature, a field magnet having a single coil surrounding the armature and standing in a plane oblique to its shaft, the magnetic circuit being composed of two hollow castings bolted together on a plane including the armature shaft, said castings containing each one-half of the journal boxes of the armature shaft.

451,574. Dynamo Electric Machine. Louis C. Rice, Denver, Colo.

The armature is made up of a series of sections longitudinally grooved upon their outer surface and suitably joined together, the upper portion of each section being cut away for the insertion of the coil, and the sections when joined together inclosing the coils at the points of contact.

451,586. Insulated Electric Conductor. James R. Williams, Oakland, Cal.

The last claim follows:

"7. In an insulated electric conductor the combination, with the dielectric, of a centering device composed of a cord which is pyramidal in cross-section and having its broadest surface next to the conductor and its apex away therefrom, and which is saturated with an insulating material not so readily softened by heat as the materials composing the dielectric and wound spirally around the conductor."

451,587. Insulated Electric Conductor. James B. Williams, Oakland, Cal.

Claim 3 reads as follows:

"In an insulated electric conductor, the combination, with a central metallic conductor provided with a vulcanized dielectric, of a centering device also surrounding the conductor and embedded in the dielectric and consisting of fibrous material saturated with an insulating material not so readily softened by heat as the materials composing the dielectric."

451,603. Magnetic Attachment for Windows. Thomas N Sterry, Norwich, Conn.

This invention is particularly valuable when applied to the windows of cars and other vehicles in which the unavoidable jolting causes such windows to vibrate and rattle.

451,605. Electric Conductor. Joseph D. F. Andrews, Westminster, Eng.

451,614. Underground Electric Wire Conduit. Henry B. Cobb, Wilmington, Del.

451,634. Telephone Receiver. William S. Corwin, Newark, N. J.

The first claim is given:

"The improved telephone receiver combining therein a permanently magnetized steel casing or tube, a soft iron core or center rod insulated therefrom at its rear end, a diaphragm, a bobbin and connecting means, and all arranged and adapted to operate."

451,637. Electric Railway System. Charles K. Harding, Atlantic, Ia.

The last claim reads:

"11. In an electric railway system an insulated main conductor provided with contact portions or electrodes protected in inclosed casings or boxes, an electrically-propelled vehicle carrying a current collector of a length at least equal to the distance between the casings or boxes, a circuit completing device normally contained in the latter, and mechanism including a cushion for preventing the noise and jar and the too rapid operation of the parts."

451,639. Alarm Signal. Michael A. O'Donnell, Chicago, Ill.

Claim 1 is as follows:

"In an alarm signal, the combination of a club or baton having a signal inserted in its handle, and a signal operating shaft of a patrol-box operated by the mouth of said signal."

451,649. Electric Stop Motion. Charles A. Dayton, Preston, Conn.

The invention consists of the combination, with the driving shaft of an engine governor, of electrically operated mechanism for throwing said governor out of working engagement with said engine.

451,656. Socket for Incandescent Lamps. Samuel Deacon, Lynn, Mass., and Merle J. Wightman, Hartford, Conn.

451,666. Watchman's Time Recorder. Edwin C. Gee, Bayonne, N. J.

451,689. Signal Box. Milton G. Davis, West Somerville, Mass.

451,691. Mechanism for Carrying Trolley-Wheels Underground. Joseph Holland, Watertown, N. Y.

Claim 1 is given:

"The combination, with the conduit-body and the side trackway shelves therein, of transverse supports between said shelves, insulating blocks mounted upon said supports, and an electric wire carried by said insulating blocks."

451,692 Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

451,696. Switch for Overhead Electric Conductors. John Kuehnle, Detroit, Mich.

451,700. Dynamo Electric Machine. Laurence N. P. Poland, Cincinnati, O.

451,730. Pole for Electric Lines, etc. John R. Fletcher, Dayton, O.

451,732 Electric Car Lighting Apparatus. Budd J. Jones, Chicago, Ill.

The invention consists of the combination, with the main lighting conductors embracing the car lamps in series in the electric circuit, of a supplementary conductor, the headlight socket piece having contact plates and the non-conducting circuit break-plug.

451,754. Ship's Telegraphic Apparatus. William Chadburn, Liverpool, England.

451,779. Cut-off for Conductors. Julius D. Shepard, Akron, O.

451,786. Method of Operating Reciprocating Electric Engines. Charles J. Van Depoele, Lynn, Mass.

The first claim reads:

"A reciprocating electric engine having one set of coils adapted to be energized by an intermittent continuous current and another set energized by alternating currents having a defined rise and fall."

451,798. Current Regulator for Electric Lamps. Charles H. Balsley, Jr., and Edwin M. Porter, Connellsville, Pa.

451,815. Conduit System for Electric Railways. William H. Ford, St. Louis, Mo.

The fourth claim is:

"In an electric railway, a switch constructed with an outer case or covering having an imperforate upper end and a projecting arm and adapted to be rocked or rotated, a contact adapted to rock or rotate with said case or covering, and a second contact fixed against rotation."

451,832. Electric Railway Pole. Foster Milliken, New York, N. Y.

451,870. Electric Motor. Ernest M. G. Hewett, Boston, Mass.

451,872. Electric Motor, Frank M. La Boiteaux, Cincinnati, O.

451,873. Fan. Frank M. La Boiteaux, Cincinnati, O.

451,884. Electric Motor or Dynamo Electric Machine. Schuyler S. Wheeler, New York, N. Y.

451,885. Method of Constructing Field Magnets of Electric Motors. Schuyler S. Wheeler, New York, N. Y.

451,894. Electric Motor or Dynamo Electric Machine. William F. Collins, Chicago, Ill.

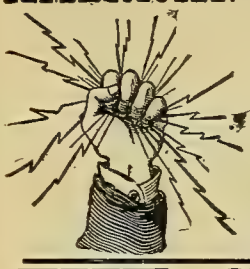
The claim reads as follows:

"An armature core for an electric motor or dynamo electric machine formed with trapezodial slots in its periphery of greater width at the bottom than at the top, the windings or conductors being contained in the slots."

451,902. Fire-Alarm Telegraph Apparatus. Joseph W. Stover, Newtonville, Mass.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



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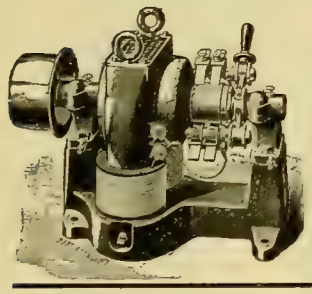

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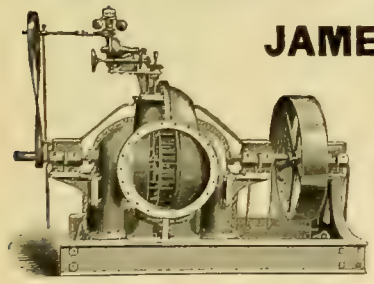

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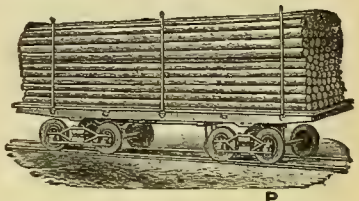

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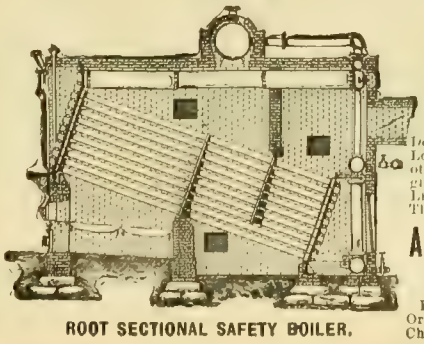

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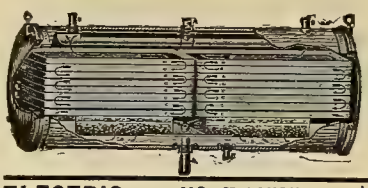

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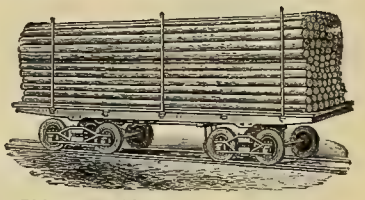

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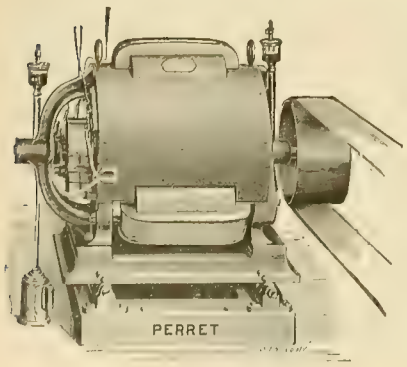

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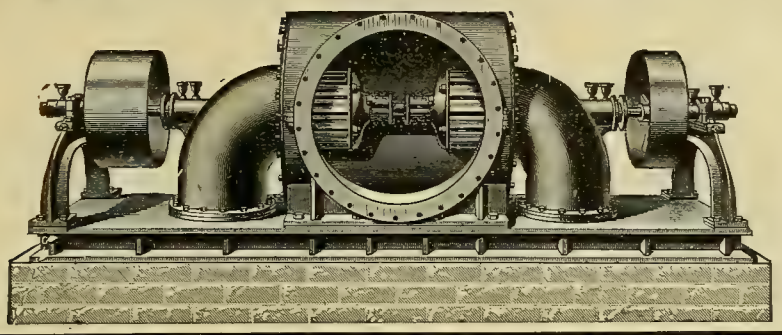

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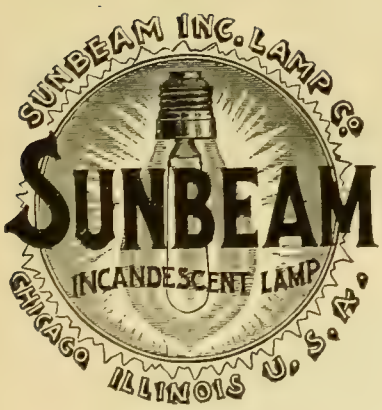

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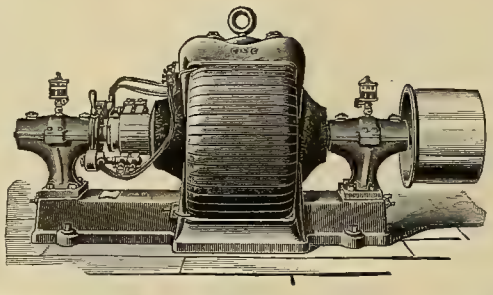

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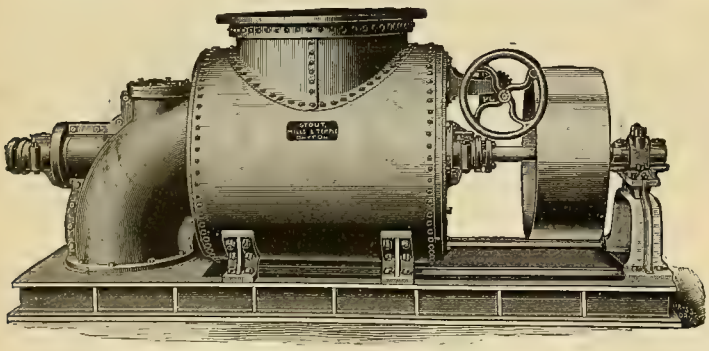

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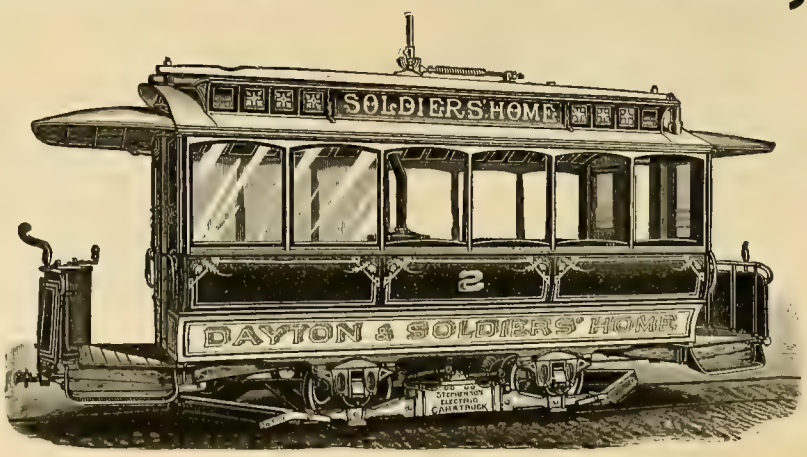

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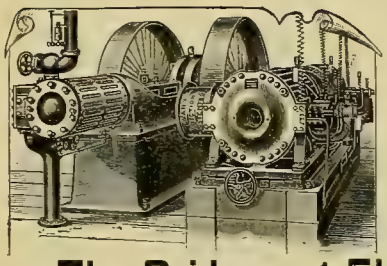
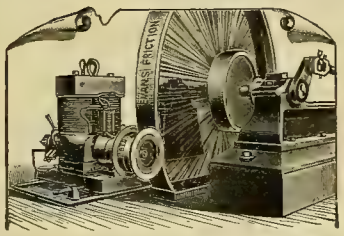
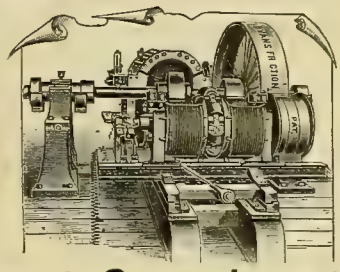

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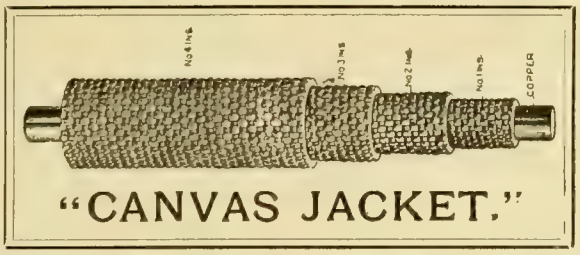

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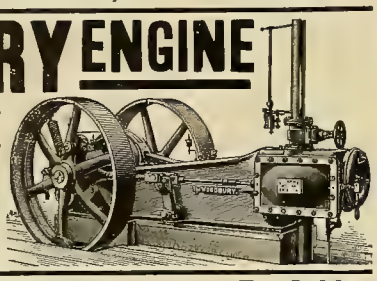

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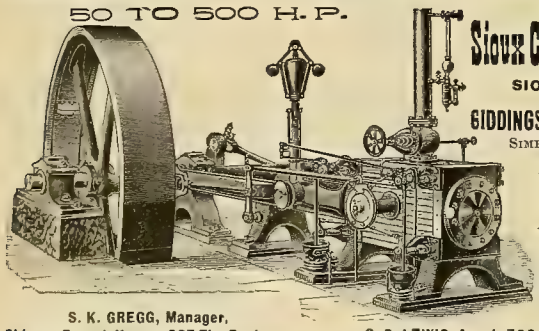

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REMEMBER That the Western Electrician enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

W. N. HOBART, Pres't. L. O. MADDUX, Vice-Pres't and Treas. J. C. HOBART, Sec'y. J. H. EICKERSHOFF, Sup't.

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Economy, Simplicity, Durability, Silence.

15 TO 300 HORSE-POWER.

COMPOUND AND VALVELESS.

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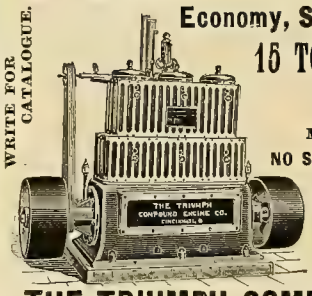

Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS.
NO ECCENTRICS. NO STUFFING BOXES.
NO PISTON RODS.
INTERNAL FRICTION A MINIMUM.
ALL PARTS INTERCHANGEABLE.

The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

THE TRIUMPH COMPOUND ENGINE CO., SOLE BUILDERS,

211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.

FRASER & CHALMERS, Agents, Salt Lake City, Utah; Helena, Mont.

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Manufacturers of

SHULTZ PATENT

IT BELTS THE EARTH AND MAKES THE MOON SPIN LIKE A TOP

FULLED LEATHER BELTING

Shultz PATENT Leather Woven Link Belt

ALL LEATHER. NO IRON ROD OR HINGE. OLD STYLE LEATHER LINK AND IRON ROD BELT AND ROPE TRANSMISSION SUPERSEDED.

SAVE YOUR POWER. YOUR BELTS. YOUR MONEY. BY COVERING YOUR PULLEYS WITH SHULTZ PATENT LEATHER PULLEY COVERING.

OUR BELTING IS TANNED ON THE SURFACES ONLY. INTERIOR IS RAWHIDE. THE ONLY PERFECT BELT MADE. NO SLIPPING OR LOST MOTION

RAWHIDE LACE LEATHER AND PICKER LEATHER.

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OUR CHICAGO BRANCH IS LOCATED AT 78, 80 & 82 Franklin St.

We Have in Stock a Complete Line of

GRIMSHAW WHITE CORE WIRES,

"B. D." WIRES,

Competition Line Wires,

Grimshaw Tapes and Compound,

AT

FACTORY PRICES.

New York Insulated Wire Co.,

NEW YORK,
649 and 651 Broadway.

CHICAGO,
78, 80 and 82 Franklin St.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

— POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF —

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.
All operations of sawing, cutting, turning and polishing our new standards of

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KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies.

SEND FOR PRICES AND ESTIMATES.

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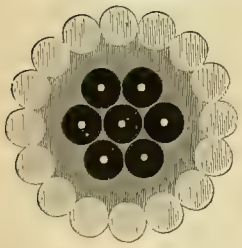
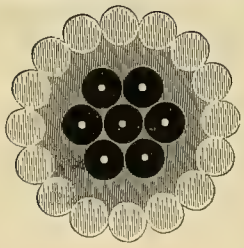
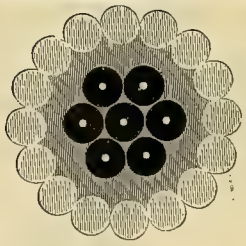
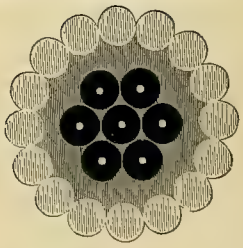
Our Catalogue of Hotel Annunciators, Bells, Pushes, and other house goods for 1891 is now ready for distribution. We shall take pleasure in mailing a copy of it to all dealers in Electrical Supplies, upon receipt of business card giving address.

WESTERN ELECTRIC COMPANY,

CHICAGO and NEW YORK.

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LEAD COVERED TELEPHONE CABLES.
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STREET CARS

FOR SALE

ON ACCOUNT OF

Increase of Business

AND THE

Adoption of Electricity.

THE

MINNEAPOLIS STREET RAILWAY CO.,

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OFFER FOR SALE THE FOLLOWING EQUIPMENT:

63 12-foot Cars, all fitted with Fare Boxes and "Small" Conveyors.
76 Extra "Small" Conveyors for 14 and 16 ft. Cars.
63 Extra "Slawson" Fare Boxes.
12 Steam Motors, 15 to 20 Ton.
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21 Passenger Coaches, 26 to 40 ft.
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Most of the cars have been in service only a short time, and all are in first-class condition. We can make changes or alterations and fit them up to suit, and will sell very cheap. The gauge of any of the cars can be changed to suit purchaser. Full description and photographs mailed upon application.

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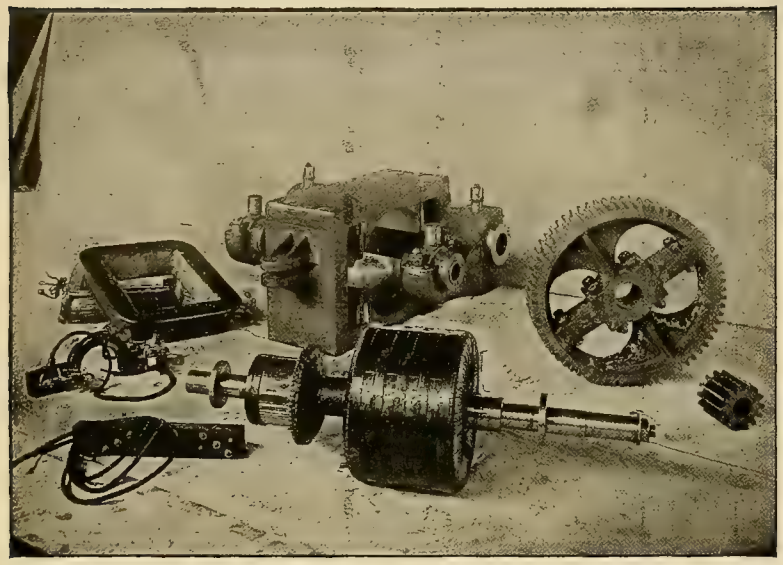
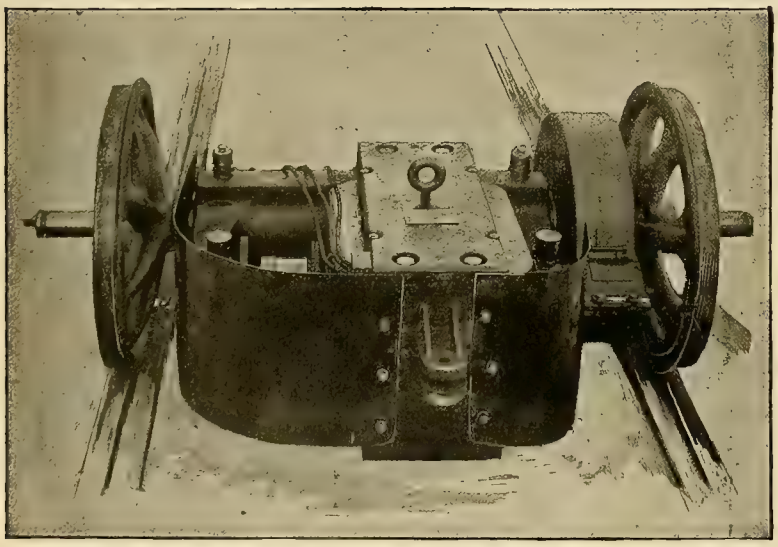
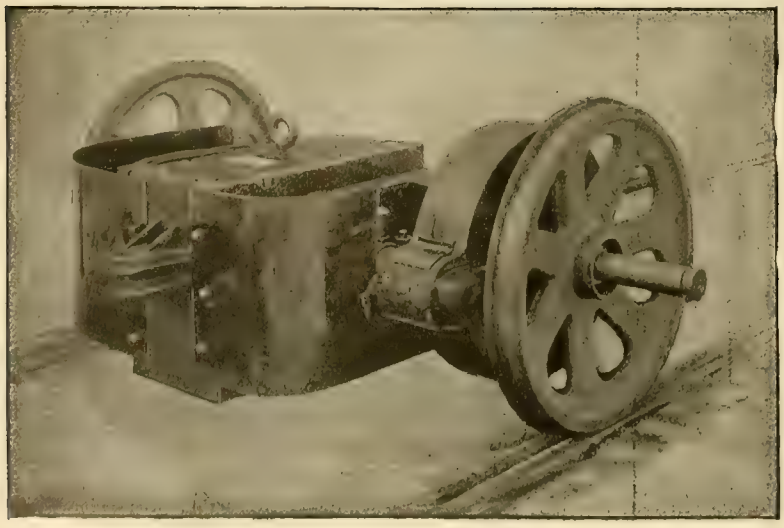
THE THOMSON-HOUSTON ELECTRIC COMPANY

Has Revolutionized the Electrical Equipment of Street Railways.







The Intermediate Shaft, Pinion and Gear have been discarded.

The Armature Pinion and Axle Gear are now enclosed in a dust-proof case filled with oil.

Reducing to a minimum the cost for repairs and absolutely eliminating the objectionable noises incident to all other systems.

The Armature speed has been reduced from 1200 to 500 revolutions per minute.

The Railway Motor, as now constructed, comprises less than a dozen parts.

The construction of the Armature avoids the possibility of a burn-out, except by malicious carelessness, and when damaged, can be readily repaired by a novice.

Don't make a mistake by contracting for Railway Equipment before seeing or understanding this marvelous machine.

Prices for Repairs, Parts and Supplies materially reduced.

Information, Prices and Literature furnished on application.

Thomson-Houston Electric Co.

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148 Michigan Avenue.

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KNAPP ELECTRICAL WORKS

GENERAL WESTERN AGENTS

The Safety Insulated Wire & Cable Co.

NOTICE.

We wish to call the attention of our customers and the trade in general to the fact that we are now the General Western Agents for the Safety Insulated Wire & Cable Co. of New York. After several years' experience with rubber covered Wires, Cables, etc., we are satisfied that the Safety Seamless Rubber Insulated Wires and Cables for Underground, Aerial, Submarine and Inside uses, are without an equal.

Our aim has always been to handle the best and nothing but the best, and until we find something better than the Safety, you will find us in position to ship promptly any quantity or sizes of Seamless Rubber, or lead covered Wires and Cables.

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PERKINS ELECTRIC LAMP CO.

Lamps to Fit any Socket.

Any Candle Power. Highest Efficiency.

OUR CATALOGUE FOR '91 JUST OUT.

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FACTORIES, ANSONIA, CONN. INCORPORATED 1880.

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THE ELECTRICAL SUPPLY CO.
171 RANDOLPH ST.

CHICAGO. May 16, '91.

F. S. TERRY, Manager.

DICTATED. **C. WHIZ.**

My Dear Sir:

Replying to the numerous favors which we have received from you, we beg to ask if you have ever "made a step in the right direction" and tried the Sunbeam Incandescent Lamp?

We also "venture the assertion" that you could "fill a long felt want" with the Habirshaw Rubber Covered Wires.

We "strike the key note" of Economy, with Shield Brand, Moisture-proof Wire—and if you will "catch on" to the combination, you can "snap your fingers at the world, the flesh and the ——."

You can "sound the tocsin," and "trip the light fantastic," because your Dividends won't be "away out of sight."

"Do you know a good th —," but of course you do, when you see it.

Sincerely yours,

THE ELECTRICAL SUPPLY CO.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive, and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having *won four distinct infringement suits* in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush invention.

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS.
INCANDESCENT LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING,
ETC, ETC, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction and Wood Arc System

OF

Electric Lighting.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM,

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

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RAILWAY MOTORS,

SLOW SPEED.
NO INTERMEDIATE GEARING.
GEARS RUN IN OIL.

EXAMINE INTO THE MERITS OF THESE MOTORS
IF A *REDUCTION IN REPAIRS* IS
WORTHY OF CONSIDERATION.

COMPLETE Railway and Power Plant EQUIPMENTS.

SLOW SPEED STATIONARY MOTORS For ARC and Incandescent Circuits.

BAXTER ELECTRIC MOTOR CO.,

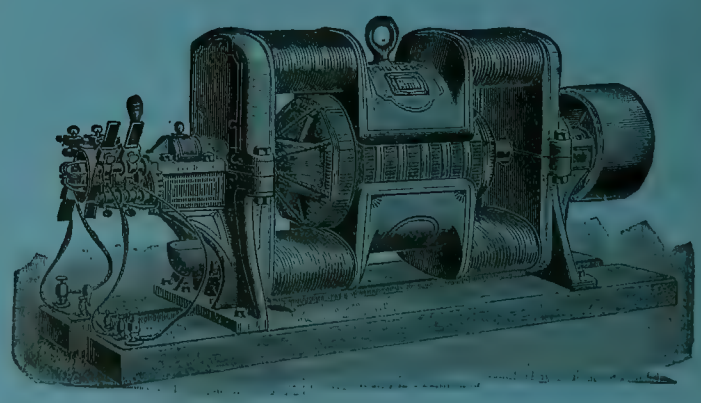
FACTORIES AND GENERAL OFFICES, BALTIMORE, MD.

THE SCHUYLER

SYSTEM OF

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.
Self-Lubricating Boxes.
Ventilated Armature, proof against a burn-out.
A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. VIII. CHICAGO, MAY 23, 1891. No. 21

"AJAX" The Best Circuit Breaker, and Only Indestructible Switch.

C. S. VAN NUIS, 136 Liberty St., New York.

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At least it furnishes a livelihood to those

Who Know a Good Thing, and They Are the Buyers of Our

CELEBRATED INSULATED WIRES AND CABLES.

THE STANDARD UNDERGROUND CABLE CO., Manufactures a Superior Line.

CHICAGO. PITTSBURGH. NEW YORK.

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MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE,

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SPECIAL AGENCIES: CLOWER & HARRIS, Dallas, Texas. PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufacture can be found at our Agencies.

Nuttall Trolley. Patents Pending.

THE BEST!

$30.00

WRITE US.

Electric Railway Specialty COMPANY,

50 Broadway, NEW YORK.

REMOVAL.

ENGINEERING EQUIPMENT COMPANY

From temporary offices, 73 Cortlandt St., N. Y. City, about May 1st,

To the "CENTRAL BUILDING," 143 Liberty St., N. Y. City.

☞ Stock room for the Underwood Mfg. Co. belts continued at 73 Cortlandt Street.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers.

F. CAZENOVE JONES, Manager of Factories.

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INSULATED WIRES AND CABLES,

For Aerial, Submarine and Underground Use.

Candee Aerial Wires.

Manson Protecting Tape.

Okonite Waterproof Tape.

OKONITE TRADE MARK

BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco.

XXIV.

Insulated Wires and Cables.

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

DAYS KERITE

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

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Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,

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THE MOST POPULAR LAMP IN THE MARKET, "A.B.C."

WRITE US FOR PRICES OF ALL GOODS.

THE "CHAMPION" BATTERY.

Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.

THE TRADE WILL BE PROPERLY PROTECTED.

Complete Cell of Champion Battery. Carbon Reservoir and Cover of Champion Battery. Corrugated Zinc of Champion Battery.

Rod Zinc of Champion Battery.

The E. S. GREELEY & CO.

5 AND 7 DEY STREET, NEW YORK.

Manufacturers, Importers and Dealers in

Electrical Supplies

OF ALL DESCRIPTION.

Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.

STANDARD ELECTRICAL MEASUREMENT APPARATUS.

NOTE THE CONTRAST!!

INCANDESCENT LIGHTS

In Central Stations July 1st, 1890.

THOMSON-HOUSTON SYSTEM.		Aggregate of All Other Systems.
4,150	VERMONT,	2,200
12,800	TENNESSEE,	1,485
1,500	SOUTH CAROLINA,	NONE.
18,450	TOTAL,	3,685

FIVE TIMES as many of the Thomson-Houston System as of

ALL OTHERS COMBINED.

The figures referring to "total of all systems," taken from table published in August number of "Electrical Industries," for year 1890, are of undisputed accuracy.	Total of all systems.	Thomson-Houston System.	
		Number.	Percentage to total of all systems.
Vermont, - - - -	6,350	4,150	$65\frac{3}{10}$ per cent.
Tennessee, - - - -	14,285	12,800	$89\frac{1}{2}$ per cent.
South Carolina, - -	1,500	1,500	100 per cent.

THOMSON-HOUSTON ELECTRIC CO.,

620 Atlantic Avenue, Boston, Mass.
Wall and Lloyd Streets, Atlanta, Ga.
115 Broadway, New York City.
15 First Street, San Francisco, Cal.
831 New York Life Building, Kansas City, Mo.

148 Michigan Avenue, Chicago, Ill.
405 Sibley Street, St. Paul, Minn.
215 West Fourth Street, Cincinnati, O.
1110 Noble Street, Philadelphia, Pa.
1333 F Street, Washington, D. C.
115 North 3d Street, St. Louis, Mo.

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Cowles Syndicate Co.
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Easton Electric Co.
Electric Construction & Supply Co.
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Mosher Arc Lamp Co.
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Thomson-Houston Electric Co.
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Monitor Electric Co.
North American Electric Co.
Partrick & Carter Co.
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Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co., The.
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Partrick & Carter Co.
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Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Wollensak, J. F.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Empire City Electric Co.
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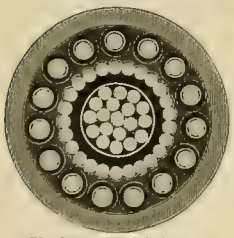

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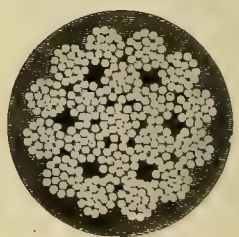
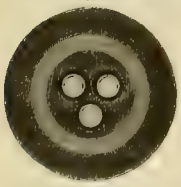
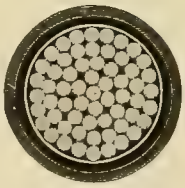


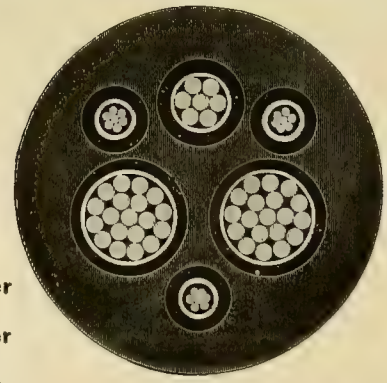
Feeder Cable, Brooklyn Edison Electric Light Co.



Underground Core, N. J. Central R. R.



Feeder Core, Broadway Theater.



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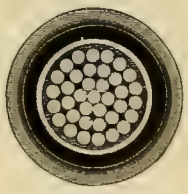

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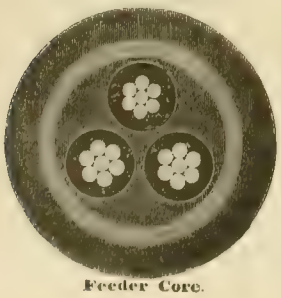

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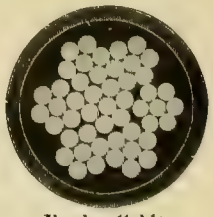

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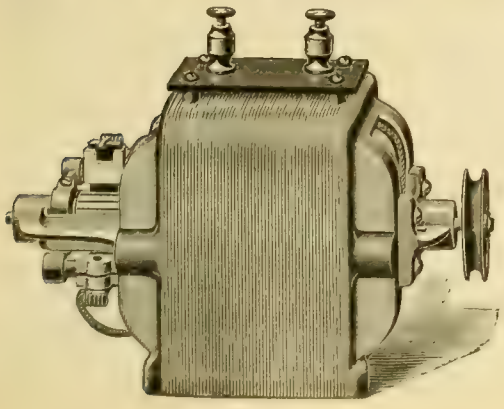

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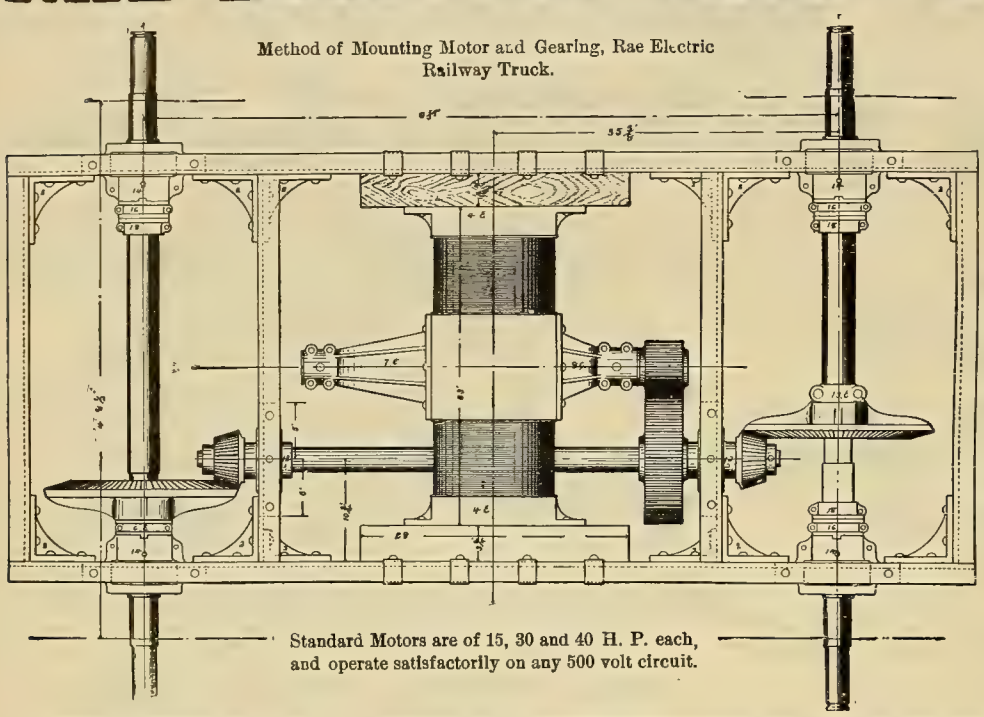

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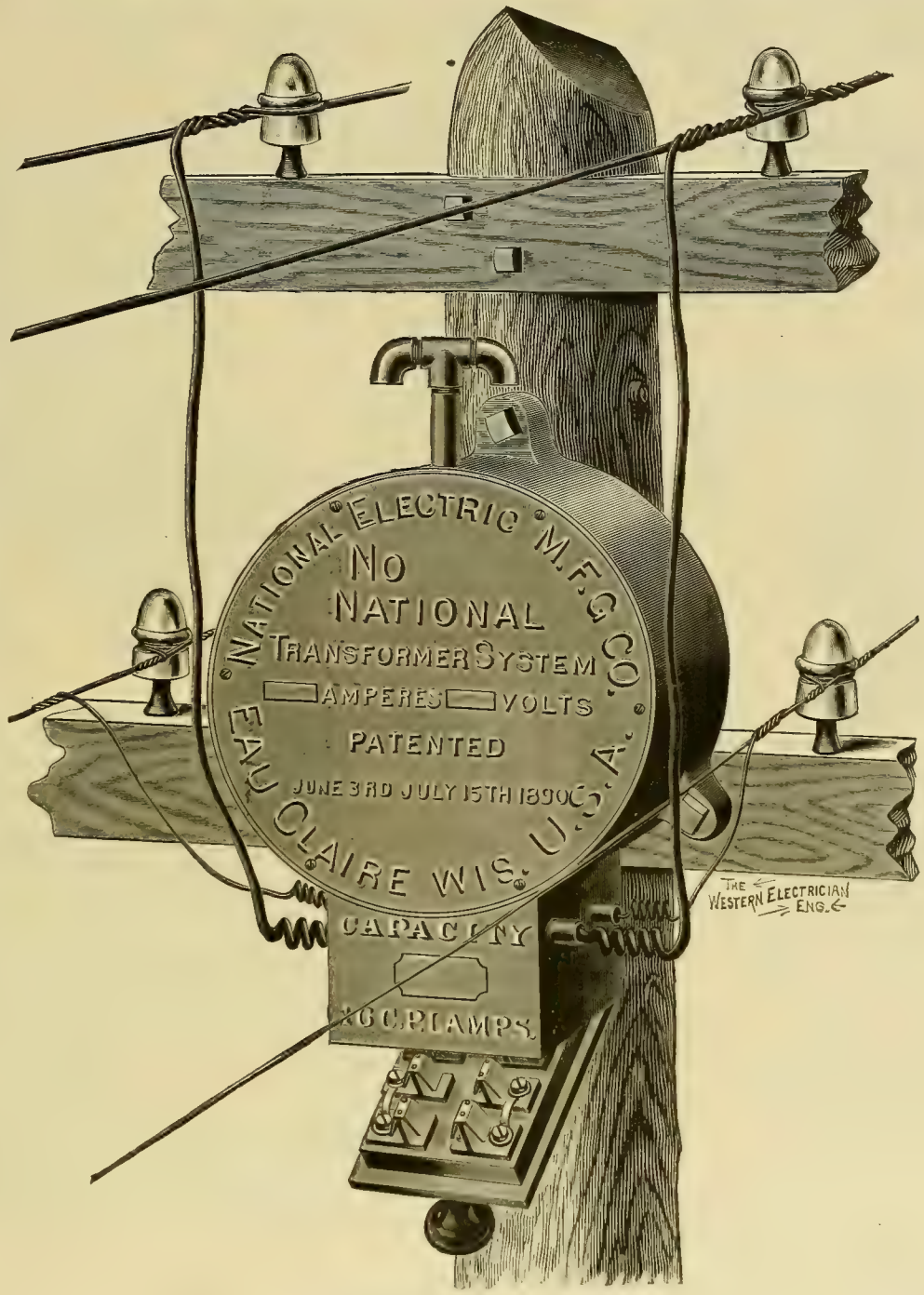

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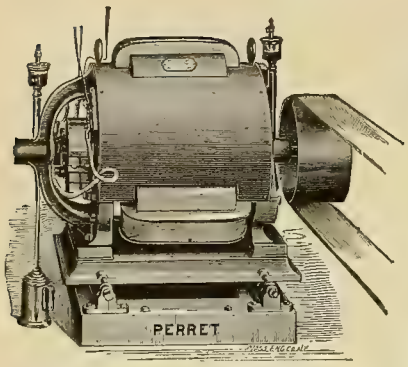

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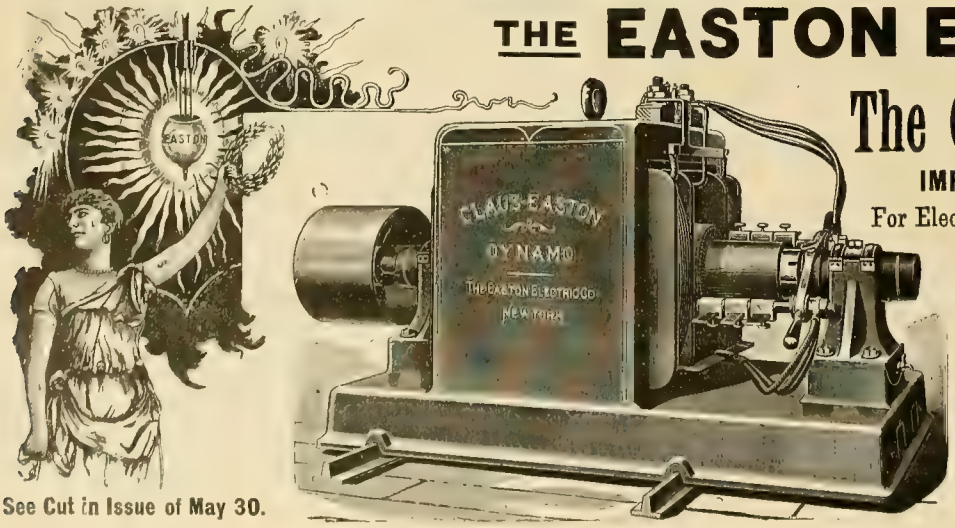

See Cut in Issue of May 30.

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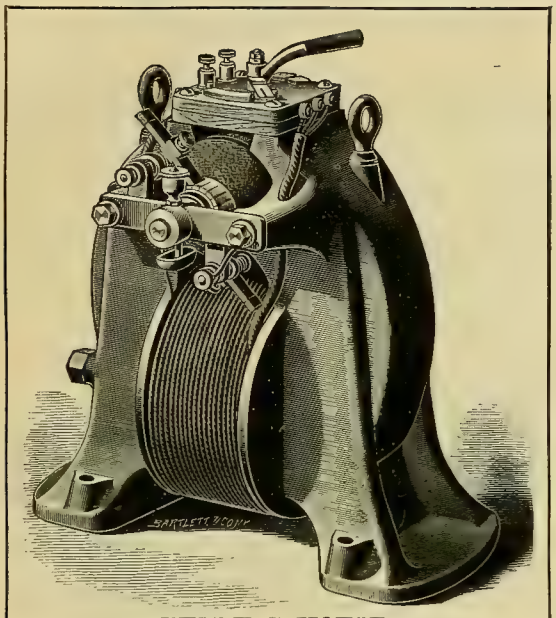

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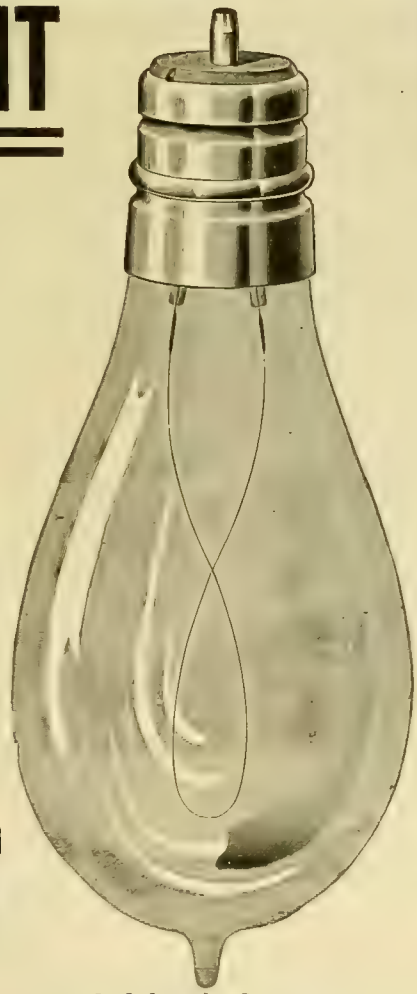

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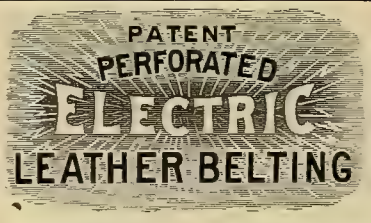

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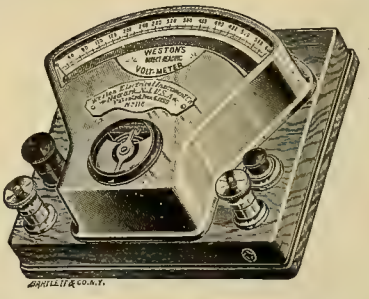

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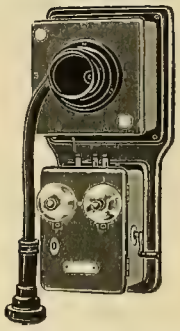

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Vol. VIII. CHICAGO, MAY 23, 1891. No 21

Central Union Passenger Station Electric Plant, Cincinnati.

The Central Union Passenger Station electric lighting plant, located at the corner of Third and Smith streets, Cincinnati, adjoining the Union depot and train sheds, was recently completed. The accompanying cuts give an excellent idea of the arrangement of the dynamo room. The plant was designd and equipped by the Central Thomson-Houston company of Cincinnati.

The structure is one story in height, and is built of pressed brick. It has a clear floor space 80x60 feet, the roof being supported by heavy truss girders. At one corner rises the massive stack towering 140 feet above the level of the street. The boiler room is located in the cellar and is arranged with every convenience for handling coal and ashes, the coal being dumped into chutes on the sidewalk and dropped directly in front of the furnaces, while a track running alongside of the station permits of readily disposing of all ashes and refuse. In the generating room herein illustrated are two 150 horse power Phoenix high speed automatic cut-off engines; they are connected with a 30 foot shaft by clutches so arranged that either one or both engines may be thrown in or out as the occasion requires. On this shaft are fitted Hill clutch pulleys from which generators are driven. There are also two ninety horse power Buckeye automatic cut-off engines driving two 600 light Thomson-Houston incandescent machines located at the south end of the building, which are on the day circuit for lighting the offices in the various passenger and freight depots. From the line shaft driven by the Phoenix engines are operated four 50 arc light 2000 candle power and one 650 light 110 volt incandescent Thomson-Houston generators, giving a total capacity of about 2000 incandescent and 200 arc lamps. There are 217 Thomson-Houston double carbon arc lamps in actual service which burn all night. They are being distributed throughout the depots, train sheds and yards and over the Chesapeake and Ohio bridge to the Covington yards. Eighteen miles of wire are used for the arc circuits.

The station is equipped with Thomson-Houston lightning arresters. A magnificent switch-board made of marble framed in hardwood, is shown in Fig. 2 (p. 289). This switch-board alone, without any of the attachments or instruments, cost $200. Edison sockets and lamps are used exclusively on the incandescent circuits. The boilers, five in number, are of the tubular type and were furnished by the Phoenix Iron Works of Meadville, Pa. Laidlaw & Dun duplex pumps and Stilwell & Bierce heaters are used, and the piping is arranged so that any or all may be worked. In the generating room is located an Ashcroft pressure indicator and recorder, which informs the superintendent what the firemen have been doing in his absence.

The station is under the immediate supervision of Jacob Heglin, superintendent of the Union depot company, with O. F. Jones, chief engineer and electrician, and is one of the most complete and best equipped and arranged plants in that section of the country.

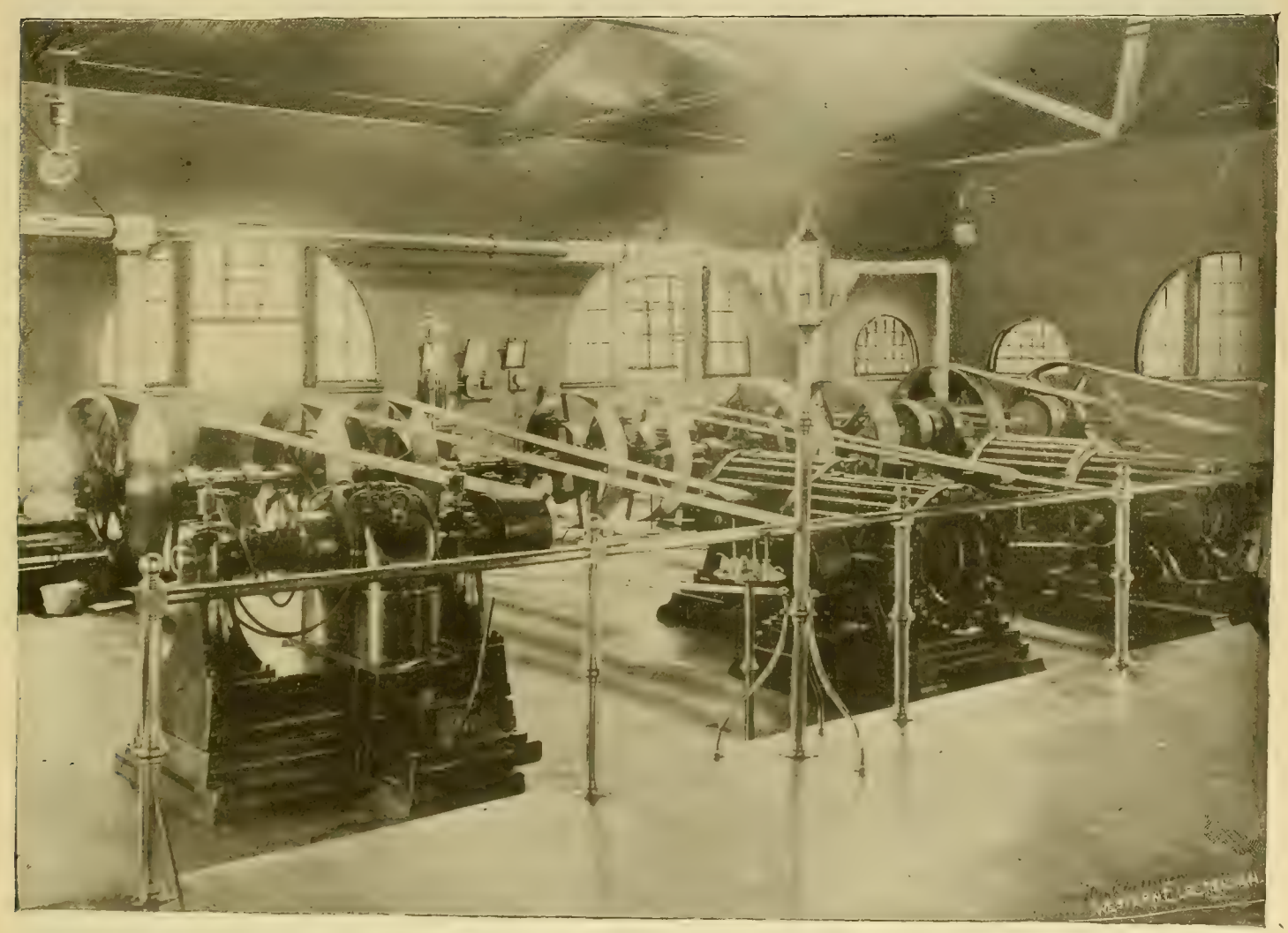


FIG. 1. CENTRAL UNION PASSENGER STATION ELECTRIC PLANT, CINCINNATI.

It is probable that telephonic communication will shortly be established between Bordeaux and Paris, France, a distance of 358 miles, as it is expected that the Chamber of Commerce and Municipality of Bordeaux will be willing to contribute toward advancing the requisite funds (about $13,000) to the French government, which, under this condition, has consented to carry out the work, and to undertake the management. Telephonic communication has also recently been established between Bordeaux and Pauillac, the port of Bordeaux, a distance of about twenty-five miles.

Electric Light Plant in the Royal Castle, Berlin.

It is well known that in electric lighting on the European continent the German capital is in the foremost rank, yet until quite recently the Royal Castle has been illuminated by wax tapers, which were fixed in richly ornamented glass chandeliers and brackets. When it was determined to make a change electricity was at once decided upon as a substitute. Gas was never considered seriously, as it was looked upon, according to the German authorities, as of too plebeian a character to be introduced in the Royal Castle. The considerations which led to the adoption of electricity were not only its superiority as an illuminant and the absence of heat, but also the fact that it would not endanger the precious pictures, costly furniture and valuable works of art from smoking. Moreover, the danger from fire where there was so much drapery was greatly diminished by the introduction of the electric light. It was also found that the costly lighting fixtures previously employed could be utilized without changing the general appearance and effect. The many advantages of electric lighting were thoroughly tested before an extensive plant was installed. In 1882 incandescent lights were placed in the "Weissen Saal" or "White Hall," which is the official reception room for royalty.

Gradually this installation was extended to the lighting of the picture gallery, hall of the knights and the other rooms in the north wing used for festivals and celebrations. Again a large extension was made when the rooms of the first floor of the south wing were arranged as the winter residence of Emperor William.

Up to this time wax tapers were still in vogue, and electric lighting was only considered an auxiliary, but in 1889 incandescent lighting replaced candles in the "White Hall" entirely. The number of chandeliers in this room was reduced from fifteen to three, greatly improving the appearance of that beautiful hall as the exquisite ceiling, with its pictures and ornaments, could then be shown to advantage.

The plant at this time consisted of three Deutz gas motors of 30 horse power each and one of 16 horse power and four Siemens dynamos. The first difficulty encountered in the installation of a larger plant was in securing a suitable place for the engine and dynamo room.

This was finally found between the "castle apothecary shop" and the river Spree, near the Kaiser Wilhelm's bridge. Boiler and engine houses are so located that they are almost hidden from view; the chimney, one of the greatest objections near structures of architectural beauty, was built as an ornamental tower. It will be readily understood that the presence of smoke near the Royal Castle would not be tolerated. It was accordingly decided to overcome the objection by using a "smoke consumer" and burning hard coal. This may be of special interest to the Chicago smoke inspector.

In the new power plant there are two Cornwall boilers, and provision has been made for a third. One steam pump and two injectors feed the boilers, and a safety device automatically reports low water.

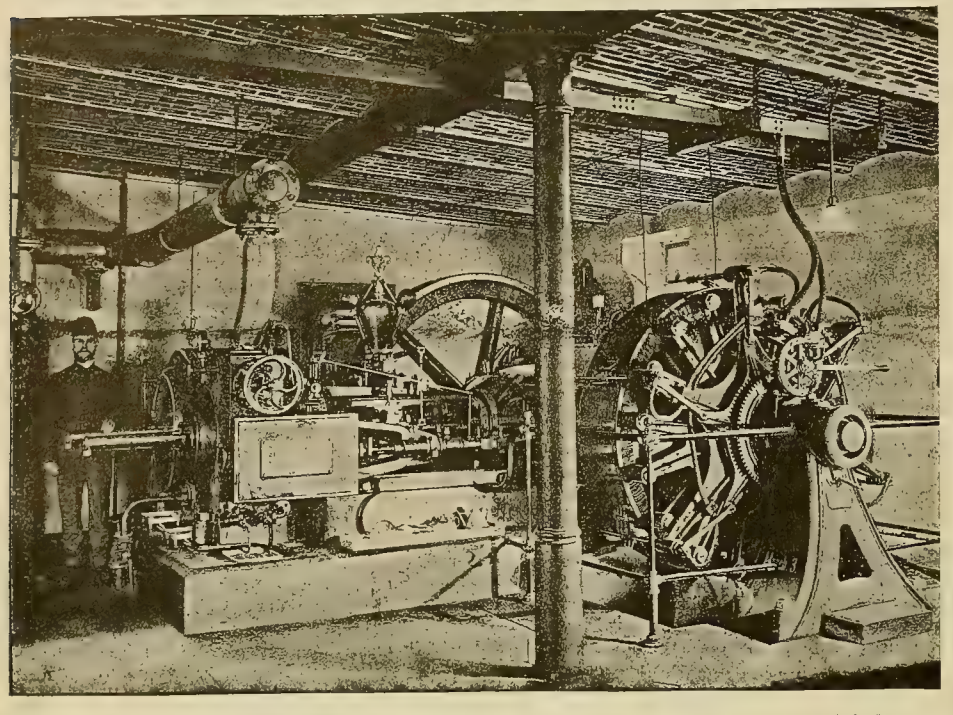


FIG. 1. ELECTRIC LIGHT PLANT IN THE ROYAL CASTLE, BERLIN.

Next to the boiler house, containing one engine of 50 horse power and one of 150 horse power, foundations for two additional engines of 200 horse power each are ready. The engines are of the horizontal compound condensing type; the smaller engine makes 200, the larger 150 revolutions per minute.

Views of the dynamo room are shown in the accompanying illustrations. The armatures of the dynamos are keyed to the elongated crank shafts of the engines, while the inner pole pieces are fastened to the bed plates.

The armatures rotate around the inner field. There is no commutator or collector, the brushes being in contact with the outer armature surface, which consist of copper rods. Special apparatus permits the simultaneous adjusting of all brushes, which coincide in number with the magnet poles. The large dynamo has six, the small dynamo four poles. Fig. 1 represents the large dynamo of 100,000 watts capacity, coupled direct to the 150 horse power engine.

Between the two dynamos is the switch-board shown in Fig. 2. It is arranged for four dynamos of a total capacity of 330,000 watts and a battery of accumulators of 860 ampere hours' capacity.

The dynamos are connected with the switch-board by means of bare copper bars fastened underneath the ceiling. Next to the dynamo room is a small repair shop, the office of the superintendent and an accumulator room. The latter contains 68 Tudor accumulators with a maximum discharging capacity of 172 amperes.

Twelve iron armored lead cables lead from the switch-board to six connecting bases. These six bases are connected with each other by equalizing bars, from which the feeders start.

The principle pervading the whole installation is to secure absolute safety of operation as well as the gratification of aesthetic tastes. A large number of safety fuses ranging from 500 to one ampere are employed. All conductors are concealed in wood mouldings laid in specially constructed and ventilated channels inside the walls.

The lamps are all in chandeliers, and the larger brackets are divided in two circuits, so that one-third or two-thirds of the total number of lamps may be lighted by means of switches located near the doors.

In the rooms of the emperor and of the imperial princes there are 557 lamps of from 10 to 25 candle power each. The corridors and staircases contain 152 incandescent lamps; the porte-cocheres nine arc lamps of six amperes each; the guardhouse, wine cellar, silver room, etc., have 133 incandescent lamps; the rooms for festivities 1,960 incandescent lamps, out of which 1,005 are employed in the "White Hall" alone.

A few electric motors drive fans in the royal kitchen and the buttery.

Accumulators alone furnish current during the day and after midnight. The steam plant is in operation only from sunset until midnight.

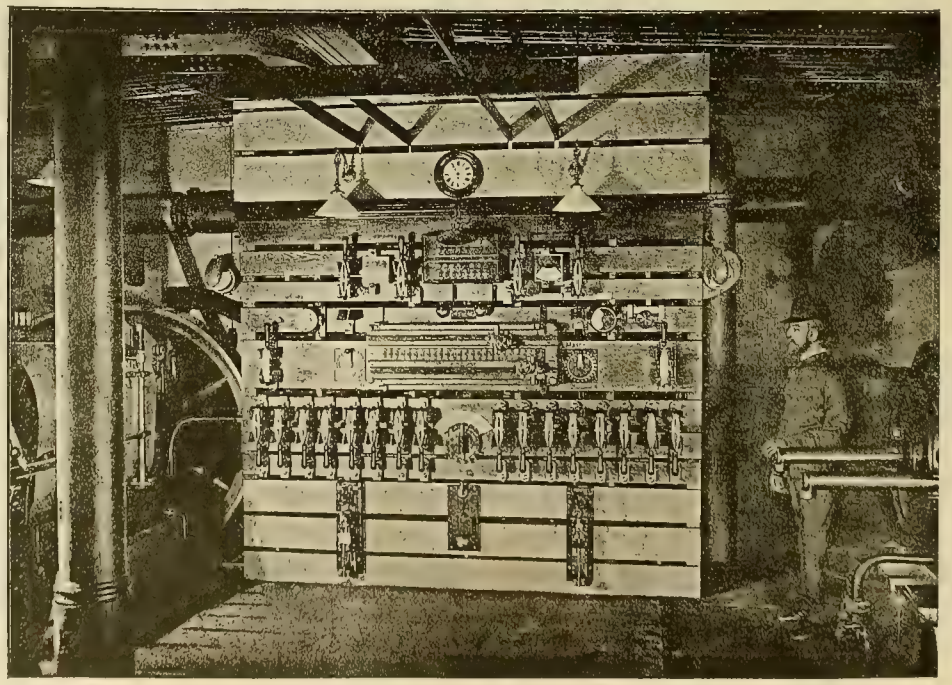


FIG. 2. ELECTRIC LIGHT PLANT IN THE ROYAL CASTLE, BERLIN.

It is said that even from a financial point this installation is a success.

The projected renovation of the "White Hall" will necessitate another increase of the electric installation. Two Siemens dynamos and another accumulator battery of 800 ampere hours' capacity will probably be installed. The cuts are reproduced from *Elektrotechnischer Anzeiger*.

Electrical Department of the World's Fair.

The chief event of interest in connection with World's Fair electrical matters during the week was Mr. Edison's outspoken advocacy of the position taken by the Department of Electricity and the general attention and interest excited by the expression of his views. The distinguished Jerseyman and Prof. Barrett had several conferences, which resulted satisfactorily to both.

During one of the early conferences of the World's Fair officials and representatives of the electrical industry Chief Burnham inquired if Edison would prefer a united exhibit He appeared to be under the impression that Mr. Edison desired to place portions of the apparatus in other buildings. This opinion was evidently shared by the World's Fair officials. At that time Mr. Edison had not announced his plans, and none of the gentlemen present felt warranted in expressing an opinion. Now, however, there can be no doubt of Edison's wishes. He has spoken freely, and as was expected, he earnestly advocated a united display and larger building than that which the construction department has proposed to devote to the electrical department. He has coincided with Chief Barrett's views, and is in sympathy with the course pursued by the WESTERN ELECTRICIAN. The construction department laid considerable stress on what it considered a division in the ranks of the electrical fraternity. It should now gracefully acknowledge its error and make suitable reparation.

To a representative of the WESTERN ELECTRICIAN Mr. Burnham, chief of construction, said a day or two ago that he expected that the electrical building would be under contract in about three weeks. He said that, so far as he knew, there had been no change in the arrangements for furnishing power. When the subject of Mr. Edison's views on the subject was broached, the chief of construction manifested a decided lack of enthusiasm and remarked that he was in ignorance of Mr. Edison's opinion, not having sought it on the occasion of the visit paid the construction department by the inventor. In relation to the matter of dividing the exhibits Mr. Burnham said that he was not aware of any change in the plans since the conference of the electrical people and the board of control.

Director-General Davis has removed the offices of the Department of Electricity to rooms 506 and 508 Rand-McNally building. The new quarters are on the same floor as the rooms at present occupied.

Fred. Sargent, consulting electrical engineer of the construction department, has been instructed to prepare specifications and estimates of the cost of lighting the harbor at Jackson Park by electricity.

Chief Barrett's plan for lighting the building and grounds, briefly outlined in the WESTERN ELECTRICIAN of last week, has greatly interested the World's Fair officials. Chief Barrett thinks that, in addition to the other advantages of the idea of having the illumination furnished by the electrical companies making exhibits, a large sum of money could be saved the exposition, as the exhibitors, who will require plants on the grounds in any event, could afford to do the work cheaper than the World's Fair authorities, who would have to erect a mammoth plant for six months' use, running their chances of being able to dispose of the machinery at the end of that time. Chief Barrett thinks that the exhibitors should be asked to furnish bids for lighting a certain building or portion of the grounds. After the offer of the lowest responsible bidder had been accepted, the others would be invited to come in and share in the work at the same price, all the companies receiving contracts. It is believed that this plan would be acceptable to the exhibitors.

The Edison General Electric company is already making preparations for an elaborate display, and unless the space of the department is curtailed the company promises to eclipse all former Edison displays. A special department to take charge of this work is now organizing under the supervision of Luther Stierenger. This department will begin at once to arrange for a display, not only of novelties and devices of historical interest, but also for a complete line of apparatus now manufactured by the Edison company. Mr. Stierenger has had much experience in this line of work, and will no doubt acquit himself creditably. The display of Edison's inventions at the Paris exposition was, according to Mr. Edison, a "big show," and did not contain commercial apparatus. While the Edison exhibit at the Columbian Exposition will be more elaborate as an historical display, it will have the advantage of showing the present condition of the art as applied commercially.

Suggestions of more or less pertinence regarding the display are continually coming in. The Chicago *Post* thinks that "a feature of the electrical exhibit at the World's Fair should be a telephone that is not always 'busy.'" The *Post* is asking too much. By 1893 it is probable that applications for conversation-time on the more frequently used telephone lines will have to be filed several days in advance.

World's Fair officials will no doubt be interested in the following observations in *Whipple's Reports* for May: "The WESTERN ELECTRICIAN is making a good fight against the contemplated contracted quarters in which it is proposed to place the electrical exhibit at the World's Fair. Our Chicago contemporary has all of the argument upon its side, and it is giving to the public a great many of the facts; but there is one fact that, to a casual observer, stands forth in bold relief, and which the WESTERN ELECTRICIAN has doubtless omitted to state because of local courtesy. Away from Chicago, however, it is justifiable to call a spade a spade in relation to World's Fair matters, and it is a pertinent fact that Chief Burnham of the construction department has accepted a position which he is utterly unable to fill. He first of all conceived the idea that the words 'Columbian Exposition' should be erased from the country's escutcheon and 'Burnham's Fair' substituted therefor. His next mistake (and it is a very serious one) is that he has been unable to accept the advice of those who have other interests at stake than the more or less architectural beauty that the buildings may depict. His idea was and is that the superintendent of the electrical department will have handed over to him a building in which all of the exhibits have been installed and ready for operation. The idea that the head of the electrical department might have any knowledge of what the electrical exhibitors require has never got within speaking distance of Mr. Burnham. If this regime continues, it will be a picnic for the electrical superintendent, but a disastrous venture for the exhibitors. In the parlance of the small boy, Mr. Burnham must come off the perch or assume the responsibility for a successful electrical fiasco."

The *Canadian Electrical News* in its issue for May says: "There is much disappointment expressed by representatives of the electrical industries of the United States as the result of the recent discovery that the dimensions of the proposed electrical exhibition buildings in connection with the World's Fair are inadequate for their purpose. Unless the chief architect can be prevailed upon to change the plans which have been prepared, the electrical exhibits, instead of being centered in one building, must be distributed among several. Such a distribution would be most unsatisfactory both to exhibitors and visitors. It is, to say the least, peculiar that Prof. Barrett, chief of the department of electricity in connection with the World's Fair, seems not to have been consulted in a matter of such importance."

In commenting on the World's Fair the London *Electrician* says: "The electrical section of the World's Columbian Exposition is starting off vigorously, and plans on a considerable scale are being drawn up. There will be active rivalry between the various electrical companies for prominent places at the exposition, and it will take no ordinary amount of skill and tact to deal with their demands satisfactorily. Mr. Barrett, the chief of the electrical section, however, is thoroughly up to his work."

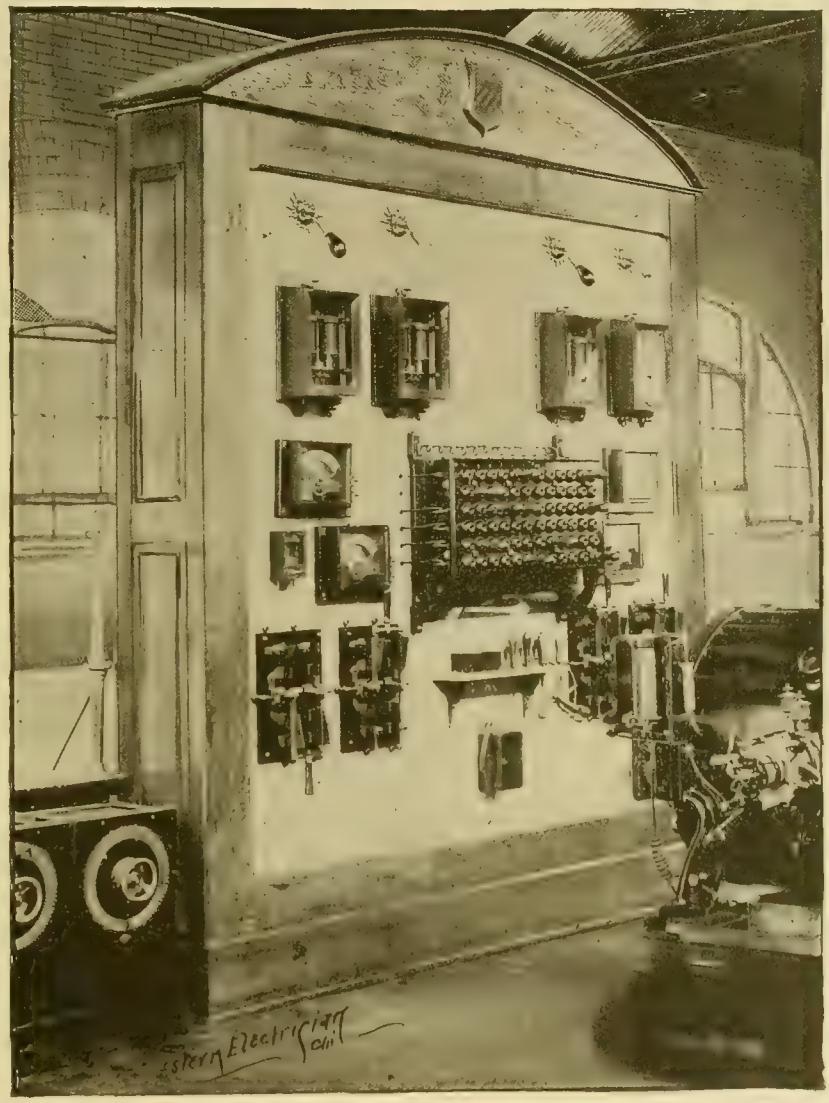


FIG. 2. CENTRAL UNION PASSENGER STATION ELECTRIC PLANT, CINCINNATI (PAGE 287).

Ries' Electric Riveting Machines.

The latest development in the line of machinery through which the heating power of the electric current may be utilized is represented in the accompanying illustrations. These three electric riveting machines were designed by Elias E. Ries of Baltimore, Md., and they possess a number of interesting features.

The general principle upon which the riveters are constructed is quite simple, being practically the same as that upon which the electric welder is built; in other words, instead of the current being employed to raise to a welding heat abutting ends of metal pieces, it is utilized to heat a rivet and bring it to a softened condition ready for forming.

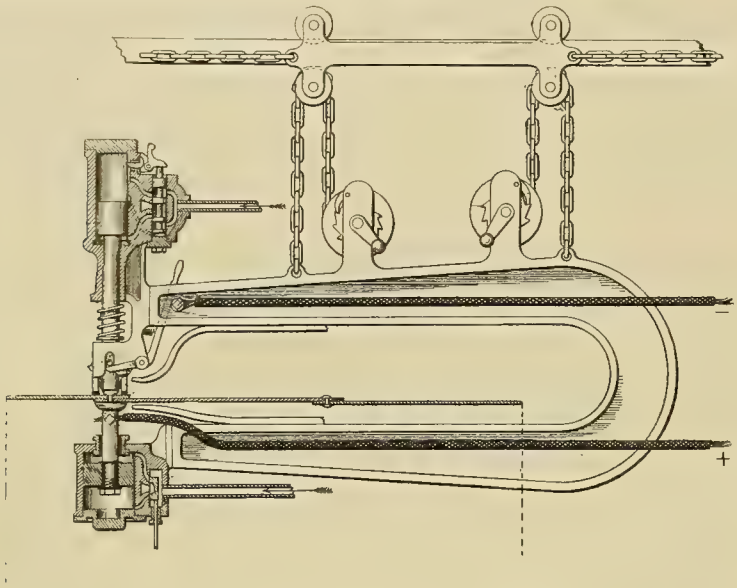


FIG. 3. RIES' ELECTRIC RIVETING MACHINES.

In the machine shown in Fig. 1 there is a heavy bar of copper *B* bent to a circular shape with the ends turned outward and parallel so as to form two brackets *M* and *N*, one above the other. These brackets support an anvil and rivet-heading die. The bar thus formed and arranged constitutes the secondary of a transformer, the fine wire primary of which is placed, as shown, parallel with and against the secondary bar.

The primary circuit includes a current regulator placed so as to be within reach of an operator. This regulator is a reaction rheostat composed of a series of resistance coils, a series of contact plates, to which the terminals of the coils are connected, a soft iron core within the coils and a switch lever arranged to make contact with the plates. An iron shell composed of two similar castings incloses the circular portion of both the primary and secondary of the transformer. The heading die supported by the upper bracket, is on the end of a threaded bolt which passes through a nut in the bracket and is provided with a hand wheel as represented. The lower end of this die has in its face a cavity in which the free end of the rivet is shaped. The lower bracket *N* carries an anvil which has a broad flat face and also a cavity to receive the head of the rivet. The flat face of the anvil is covered with a sheet of insulating and refractory substance such as mica. The anvil is raised and lowered by a hand wheel and screw.

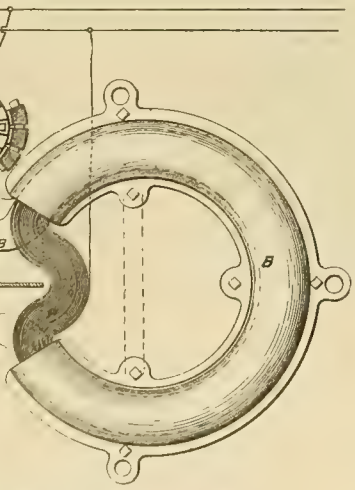
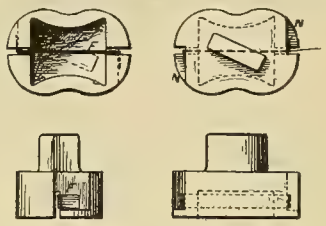


FIG. 1. RIES' ELECTRIC RIVETING MACHINES.

The operation of riveting with a machine constructed as shown in Fig. 1 will now be understood. A rivet is placed with its head, or, if there be no head, with one end of its shank, in the cavity in the face of the anvil, and the shank itself passes through the rivet-holes in the plates. The operator manipulates the anvil hand wheel until the plates are clamped against the lower ends of the legs The heading-die is then screwed downward until in contact with the upper or free end of the rivet-shank, and the current is passed through the rivet to bring it to the desired heat. When in the proper condition the heading die is further depressed to upset the softened end of the rivet, and form a head.



WHITTINGHAM'S THERMAL CUT-OUT.

As a means for cooling the heated parts of the riveter, Mr. Ries employs an air jet, which is directed against the lower end of the heading die, or he uses liquid circulating devices.

The machine illustrated in Fig. 2 operates on the same principle as that of the first described riveter. In this last machine, though, the process of heading the rivet after it is in place is carried on through the aid of steam or compressed air. A cylinder and piston *C* is embodied, as shown, in the machine, and this arrangement being controlled by a pedal, enables the operator to apply the air or steam, and obtain any desired pressure.

In Fig. 3 is represented a type of riveter designed especially for large work.

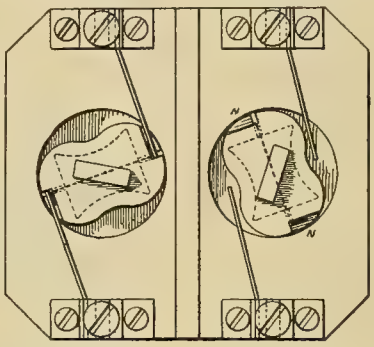
Telephone Litigation.

Judge Blodgett of Chicago has entered a decree against Arthur F. Arnold enjoining him from selling telephone receivers. Arnold, it was claimed, made the receivers in a place on West Madison street, and made a large amount of money. The complaint was made by the American Bell Telephone company, and the defendant made no answer to the company's bill for an injunction, but when the case came to be heard Arnold claimed that, although he did sell the receivers, he sent them out uncompleted, and the persons who bought them put the parts together, and that if any one was infringing it was the people who bought them.

Whittingham's Thermal Cut-out.

Among the numerous and ingenious devices brought out by Geo. H. Whittingham of Baltimore, Md., is the little fixture illustrated by the cuts. In designing this cut-out Mr. Whittingham's object was to cheapen construction by simplifying the structure, as well as to make a cut-out device in which, when the fuse has been burned, it can be quickly replaced without the use of any instrument, not even a screw driver.

In the illustration two fuse devices in the two positions are shown. One of these cut-outs is represented with the fuse in the circuit and the other with the fuse-holder at right angles to its former position.



WHITTINGHAM'S THERMAL CUT-OUT.

The base of the cut-out is made of porcelain, and in its center is a circular socket of slight depth, in which the fuse-holder proper rests and revolves. The fuse-holder is a cup of porcelain, provided with a handle on the top. The cup is shaped so that its ends are convex, and the sides concave. The long diameter of the cup is a little less than the diameter of the socket, so when the cup is in the socket it can just turn snugly in its place. The cup is held, as shown, between two contact brushes. The operation of the device is evident. When the cup is turned so as to place the longer diameter of the cup between the extremities of the brushes, they will fall into the notches *N N* and upon the ends of the fuse *F*, thus establishing a circuit between the brushes. If now the fuse is burned by an excessive current, a quarter turn of the cup from the position shown on the left in the cut to the posltion shown on the right will release the cup from the hold of the brushes. It may now be taken from its socket and a fresh piece of fuse inserted in the slot, the ends being bent, as already described, in opposite directions, into the notches.

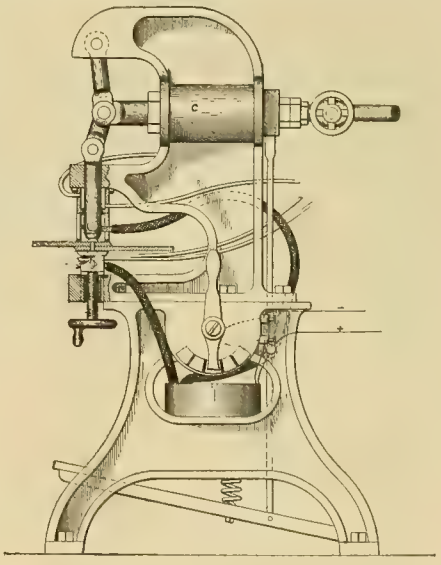


FIG 2. RIES' ELECTRIC RIVETING MACHINES.

It is reported that a direct cable line between England and Germany will soon be laid. At present the telegraphic relations between the two countries are sustained by cables laid down on the French, Belgian and Dutch coasts. The new cable now under consideration will therefore form a fourth telegraphic line across the English channel and the adjacent portion of the North Sea.

The Pittsburg Telephone Exchange.

The quarters of the Pittsburg Telephone company, which are now situated on the sixth floor of the First National Bank building, have long been too cramped for the accommodation of the large amount of business done by that corporation, and the company some time ago decided to erect a building more suitable for the growth and the demands of the work.

It was not, however, until last year that the company was enabled to secure a suitable location, as the site must necessarily be commodious and central at the same time. This location was at last found on the corner of Seventh avenue and Cherry alley, formerly occupied by the First Evangelical Lutheran church.

The building, which is now nearly completed, and a cut of which is shown herewith, is of brick, with Portland brown stone for the first story and trimmings. The structure will present, when finished, a very attractive appearance, and it will certainly constitute an architectural ornament in its immediate neighborhood. The building will be equipped with the most complete electrical appliances for telephone work known up to date. Henry Metzger, the general manager of the company, has stated that every appliance that is known to insure superior service will be used. The metallic system will be introduced at the same time, which will greatly improve the service, about which there has been much adverse criticism. The defects of the present service are attributed to the use of single wires, not from any carelessness or indisposition of the company to give the very best service. The company has found it necessary to erect this building in order that the needed expansion might be made, and is pushing the work with all possible speed. It is expected that the entire apparatus of the company will be installed in the new building next fall.

THE PITTSBURG TELEPHONE EXCHANGE.

Novel Use of Electric Light.

Readers of the WESTERN ELECTRICIAN will remember the publication of an article in the issue of December 20th in which was described and illustrated a means resorted to by Bavarians to destroy forest bugs in the park at Munich. In this device the electric light was used to attract the insects to the machine, in which they were destroyed. Another interesting instance is reported, where the electric light is known to attract worms out of the earth.

In New Haven, Conn., according to the *Register* of that city, the electric light attracts the squirming creatures, which are then collected by boys, who sell them to fishermen for bait. The paper alluded to says that groups of boys can be noticed at work in the night under the electric lights. The boys are equipped with small tin cans. It is supposed that the electric light is the attraction. The worms come to the surface to see what all the brilliant illumination means. Evidently the glare pleases them or has a soothing effect of some kind, for they bask in the dazzling rays and seem to have little anxiety to return to their earthy habitations.

Electricity in Mining.

By STEPHEN BARTON.

There are many small mines, and large ones, too, for that matter in California which have been abandoned for many years, because of the cost of fuel, transportation of ores, etc. From the door of my house I can see, with a field glass, the abandoned works of the once famous Harley mine. Mining journals abounded with illustrations of the manner in which rugged nature had been overcome, and auriferous ores handed down from crag to crag by means of a cable tramway two miles long. The tramway took the ore from an altitude of 3,000 feet above Kern river, and landed it on the banks of one of the noblest mill streams in California, to be reduced by steam power. To keep a costly plant employed, thousands of tons of gray granite were shipped down the mountain and crushed with the vein matter. In a few years the richer ore bodies were so far worked out that it was no longer possible to maintain a number of high salaried officers, equal to the number of laborers employed, and the property was abandoned; $500 worth of iron pipe would convey water to this mine from a mountain stream sufficient for amalgamation and other purposes. A small cable would suffice to transfer to the same point adequate electric power, which would be generated by a wheel now standing idle on Kern river, owned by another company, and this mine could again be made to yield up its hidden treasures with but comparatively little expense.

This is but an epitome of what may be seen almost anywhere in the mining region of California. Small mines, in inaccessible places, are abandoned because of lack of means of transportation or adequate means of reducing the ore. Small springs with a fall of 500 or 1,000 feet will, in the future, be employed to generate electricity, and a system of cheap plants will yet reduce the ores directly on the dumps. Intelligent mining will no longer deem it necessary to transport thousands of tons of ore down a steep mountain side for no other conceivable purpose than to get gold bullion nearer market.

In another way is the new era of gold mining awaiting the advance of electric appliances. Several streams in California have not yielded placer gold. I may mention the South Yuba below Meadow Lake for twenty miles, or to where it crosses the Blue Gravel channel, the Kaweah and the North fork of Kern river, above Kernville. On all these streams rock paying almost fabulously rich in gold has been found, but the gold was, in all cases, in a refractory combination with other metals and earths to such an extent as to defy the skill of the metallurgist. Electricity will yet be employed as a reagent in dissolving this union, and then, perhaps, the richest auriferous formations of California will contribute their wealth to enrich the commerce of the world.

Edison Interests in Chicago.

As the result of negotiations that had been pending for some time the six-story building at 173 and 175 Adams street, Chicago, has been leased by the Edison General Electric company for the offices of the central district, which embraces thirteen states. The papers were signed last week, during the recent visit of Thomas A. Edison to Chicago, and the company will move into its new quarters as soon as the building can be made ready. The structure has a frontage of 50 feet on Adams street and is 175 feet deep. When fitted up for its new use the building will contain, beside the offices and storerooms, a show-room and a department for the display and sale of electrical supplies manufactured by the Edison company. Considerable space will be given up to the decorative bronze work made by the company. The building has been leased for eleven years.

It is probable that the offices of the Chicago Edison company will also be removed to the newly leased building, thus consolidating the Edison interests in Chicago under one roof. This removal is in line with the contemplated enlargement of the Edison lighting plant in Chicago. The details of this scheme do not appear to have been definitely settled as yet, but the plan contemplates a system of exceptional magnitude and the establishment of several stations by which illumination can be furnished to all parts of Chicago and the suburban districts as well. The two existing stations will, of course, form a portion of the enlarged system. It was this plan that occupied the greater portion of Mr. Edison's attention while he was in Chicago.

It is said that many of the wealthy residents of the City of Mexico have electric light attachments on their carriages. Current is supplied by a secondary battery, placed under the driver's seat. From the battery wires extend to the two side lamps, to a small cluster in the top of the carriage inside and along the backs of the horses over their necks to a small lamp on their foreheads, between the eyes. If one likes he can have lamps of different colors distributed all over his carriage and horses.

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W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. B. O'HARA, - - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - - Associate Editors.
W. E. KEILY, - - - - - - - - - - - Associate Editors.
J. L. BAKER, - - - - - - - - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THERE seems to be little doubt that the management of the World's Columbian Exposition is determined to persist in its error, entirely disregarding the protest of the electrical fraternity with reference to the size of the electrical building at the World's Fair. At a meeting of the grounds and buildings committee of the local directors last Monday Chief Burnham was authorized to advertise for bids for the construction of the electrical building. This action is in line with the decision of the Board of Control that the plans for the building could not be changed. It simply means that a building will be erected that is insufficient to meet the requirements of the Department of Electricity. And this after the fact has been repeatedly called to the attention of the Construction Department and the higher authorities of the exposition. At any rate, the responsibility has been placed where it belongs, and should the electrical display prove a failure, comparatively speaking, the people will know where the blame rests.

No action has as yet been taken by the committee in reference to the resolution of the board of control indorsing General Davis' plea for a power house adjacent to the building.

It is worthy of notice that the insinuations of the opponents of the electrical interests, that Mr. Edison did not advocate a united exhibit, were promptly met by that gentleman on his arrival in Chicago. He approved everything that Chief Barrett had recommended, and indorsed the action of the local representatives of the electrical interests. Furthermore, he warned the officials of the fair that in denying the electrical department the space it desired, they were throwing away the greatest opportunity thus far offered them of making the exposition unapproachable as a demonstration of the advancement that has been made in the present generation.

If other evidence is needed to show the unaminity of the electrical fraternity on this subject, reference to quotations from electrical papers in another column, as well as those presented in previous numbers, will convince any unprejudiced mind of the desirability of the change.

The electrical people have not yet given up hope. They will continue to keep their grievances before the public, and when it shall be proven beyond all doubt that the proposed building is inadequate, they cannot be held responsible.

IN this issue is described another application of the heating effect of the electric current. Closely related to the welder, the electric riveter will undoubtedly find an extended field of usefulness. With the welder in the smith shop and the electric riveter in the boiler shop, there would be a marked abatement of the two great nuisances, smoke and noise. Cost of operation would seem to be the only drawback, and if the exploiters of the electric riveting process can demonstrate a cheapness approaching that of old time methods, a rapid introduction will be assured.

CONSIDERABLE attention is being devoted to municipal lighting at the present time. The favorite battle ground is New England, and Boston and Providence are the points at which the advocates of the new order of things are most powerful. In the latter city the Advance club applauded the socialistic principles advocated by its president, D. M. Thompson, and approved his suggestions. Mr. Thompson believes that the people should turn over to the politicians the great public works, placing at their disposal a small army of employees dependent entirely upon the favor of the rulers of the party in power.

Practical men, however, will see at a glance that such a system would entail almost endless corruption. The employees of the government would develop into an active political body seeking to perpetuate the administration under which they secured employment. Theorists maintain that this could only be done by giving the people an admirable administration, but in this again practical men will differ with them. It is the aim of every political party to secure control of the administration and dispense public patronage, thereby gaining strength and controlling the services of that element of the population known as political workers. Under the present form of government this class is found to prove a powerful factor. Its presence may be an evil, but the theorists who seek an ideal system of representative government cannot hope to raise the standard of American politics by placing additional power in the hands of these men. It is true that many public enterprises holding valuable franchises have abused the privileges granted them, but there are other means of correcting these abuses than that advocated by the New England theorists.

The attitude of the leaders of this "reform movement," so-called, is open to criticism. Many of them are identified with enterprises hostile to those which they seek to place under governmental control. On the other hand there are many honest advocates of the theory who permit themselves to be led by designing men. They should realize, however, that in attacking these great public enterprises which have done so much toward ameliorating the condition of their fellow men, they are threatening the prosperity of the country. The wholesale enactment of laws similar to those introduced in many state legislatures during the last few years can have but one result. It will discourage invention, drive capital from the country, and the progressive era which has been the pride of every American will end. It will then be too late for the idealists to undo their work. They will have had an opportunity of testing their pet theories to their hearts' content.

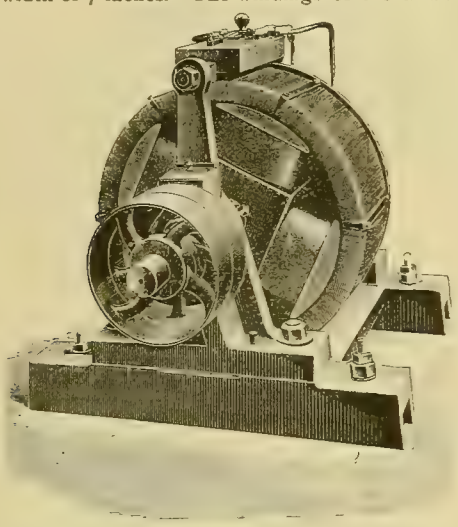
IT is a significant fact that, whatever differences of opinion have arisen as to the best manner of lighting the buildings and grounds of the World's Columbian Exposition, no one has ever doubted that electricity should be used to furnish the illumination required. In the words of an official circular from the Department of Publicity, "Gas is to be used as little as possible, and only when demanded for set purposes of manufacture, or very late lighting." Heretofore the gas people appear to have accepted the situation philosophically, but the last number of *Progressive Age* contains an article entitled "Gas at the World's Fair," in which this passage occurs:

"It is evident that an attempt is being made by interested people to discredit gas as an illuminant, and force into undue prominence the claims of electricity. The electricians are determined to make capital out of the fair, and that at the expense of the gas industry. Gas will not be given any prominence by the management. * * * * It will not be enough to appoint a committee to look after the interests of exhibitors. More is demanded. There must be a building, or part of a building, set apart for the use of exhibitors of appliances, illuminated and heated with gas. If the gas association does not devise some method of showing the superiority of their product to electricity for general illumination, its applicability to the economical generation of power, cooking of food, etc., the impression that has apparently been made upon the World's Fair management, that gas is the light of the immediate past, and electricity the only illuminant suitable to the present and future, will surely spread to tens of thousands of visitors, with a consequent loss in gas consumption and depreciation in gas securities."

In relation to the statement that the electrical people are attempting to discredit gas at the World's Fair with the object of booming their own product, we can assure *Progressive Age* that it is entirely mistaken. The exposition authorities themselves, without any outside influence whatever, have never considered any means of lighting other than electricity. The electrical interests have not the slightest wish to hinder in any way an exhibit of gas heating and illuminating appliances. But our friends, the gas manufacturers, should meet the inevitable gracefully and not attempt the bootless task of blocking the wheels of human progress. The day for presenting arguments showing the superiority of electric lighting has gone by, and the fact now goes without saying. If the gas people are equal to the task of devising any "method of showing the superiority of their product," they are very welcome to do so. So far as the electrical fraternity is concerned, nothing will please it better than a fair and honest comparison. Extravagance of assertion and unfair accusation will only be found on the side of the defenders of the gas jet.

The Haselwander Dynamo and Motor.

The accompanying illustrations show the Haselwander alternating dynamo and motor, which was exhibited and tested by the Elektrotechnische Gesellschaft at Frankfort-on-the-Main. In this machine the armature is stationary and constitutes the outer part of the machine. The field magnets, built in the form of a cross mounted on a shaft, rotate inside the ring-shaped armature. The core of the armature is made of laminated sheet iron rings of 16 inches outside diameter by 1⅛ inch radial depth and a total width of 7 inches. The windings of the arma-



THE HASELWANDER DYNAMO AND MOTOR.

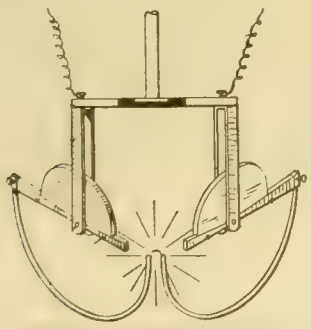
ture consist of 12 sections, each having 52 turns of No. 17 B. W. G. copper wire. The ends of the sections are joined with brass contact blocks, placed on a wooden ring, which covers the side of the armature. By this arrangement the sections of the armature can be coupled in series or multiple series, according to the electro motive force desired. The field magnet cores are made of cast iron and each of them is wound with 24 layers of wire of 28 turns each of No. 19 B. W. G. The total weight of the machine is 606 pounds and its output at 960 revolutions, in accordance with the coupling of the armature sections, is respectively 50 volts by 48 amperes, 100 volts by 24 amperes or 200 volts by 12 amperes.

By the application of a commutator on the end of the shaft, as shown in the cut, the machine can be utilized as a self exciting continuous current dynamo.

The Haselwander dynamo and motor is handled by W. Lahmeyer & Co., Frankfort-on-the-Main, Germany. The illustrations are reproduced from *Elektrotechnischer Anzeiger.*

Ingenious Arc Lamp Mechanism.

An impracticable but most ingenious feed mechanism for an arc lamp is represented dia-



INGENIOUS ARC LAMP MECHANISM.

grammatically in the accompanying cut. A glance at the figure will enable the reader to understand the operation of the device. The carbons employed are curved and are normally balanced in the relative positions shown. As the tips of the carbons burn away the equilibrium of each pencil's hanger becomes disturbed, that is, each balanced member becomes heavier, relatively speaking, at its outer end, and as a consequence there is an upward feeding of the curved carbons.

Columbia Tower and Water Palace at the World's Fair.

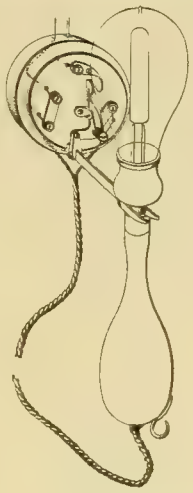
The Columbia tower and water palace at the World's Columbian Exposition are now assured, it is announced.

The water palace has been declared by the directors to be a thing of unusual beauty. It is to cost $600,000, and be located on an island in the improved portion of the park.

The Columbian tower will cost $3,000,000 and be 100 feet higher than the Eiffel tower. The soundings taken for the foundations in the Midway plaisance show that at a depth of seventeen feet a stratum of clay fifty feet thick is reached. On this the foundations for the sky-scraping structure will be built. Both of these structures will afford excellent opportunities for displaying electric lighting effects.

Automatic Hook for Portable Incandescent Lamps.

The little device illustrated herewith, although somewhat crude as far as the mechanical arrangement is concerned, might be so modified as to become a useful fixture. The hook was designed for the purpose of holding a portable incandescent lamp. The connections are such that while the lamp is on the hook an open circuit will be maintained. When, however, the lamp is removed the switch, in connection with



AUTOMATIC HOOK FOR INCANDESCENT LAMPS.

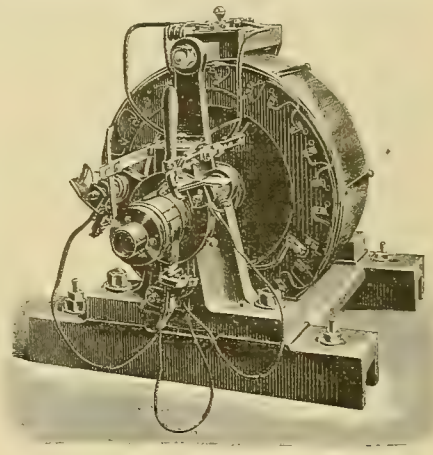
the hook, automatically closes the circuit, and thus lights the lamp. This lampholder is the invention of W. W. Savage of Toronto, Ont.

Installing an Electric Plant in Guatemala.

An electric light station in Quezaltenango, Guatemala, was described in the WESTERN ELECTRICIAN of May 2d. The station is equipped with the Ball system. Harry I. Skilton, of Skilton & Sons, New York, who control the Spanish-American territory for the Ball company, related some interesting experiences in connection with the installation of this plant.

The chief difficulties under which manufacturing companies labor is in securing transportation for their products in that country. The idea of carrying a dynamo, engine or other heavy machinery through such a country, is simply out of the question. Railroading is unknown in these wild mountain districts and it is equally impracticable to penetrate this country with large vehicles. This, no doubt, has greatly impeded the progress of the country and has proved an obstacle to the development of its natural resources.

In the instance under consideration the Ball company overcame the difficulty by employing pack mules to carry the apparatus through the mountains. After the machines for the generating plant were manufactured and tested in the company's factory they were taken apart and shipped to Guatemala. Before they reached their final destination it was necessary to carry them 300 miles through the mountains. It was here the pack mules were utilized. When they were finally delivered at their destination the machines were once more set up. They have been operated ever since with satisfaction. The success that attended this difficult undertaking led many interested mine owners in Spanish-American countries to investigate the subject, and it is probable the experience thus secured will prove valuable. Preparations are being made to equip several large mines with electrical machinery throughout. There is an abundance of water power supplied from mountain streams, but heretofore it has been impossible to utilize it, and it has been allowed to run to waste. The introduction of electrical machinery will enable the owners of this property to develop their natural resources. This will open a wide field for the electrical engine, and will no doubt re-



THE HASELWANDER DYNAMO AND MOTOR.

sult in the rapid development of this interesting country.

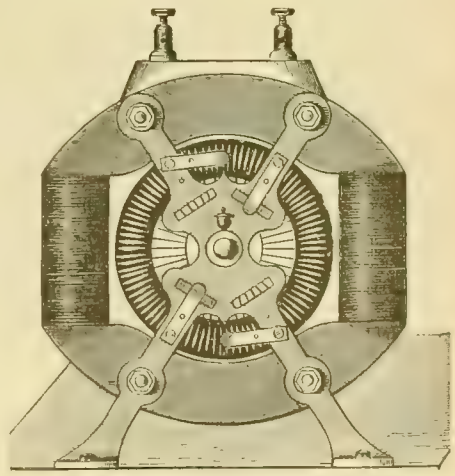
Gutmann's Alternating Motor.

This motor was constructed to drive small machinery like ventilators, sewing machines, etc. It is self-starting, and its speed is independent of the number of alternations of the current.

The principle of construction is based on the short circuiting of a certain number of armature coils and thus generating induced currents; these latter create poles, which are alternately attracted and repelled by the magnetism of the field, and thus cause a rotation of the armature.

The subdivisions of the armature winding are connected to a collector on which rest a number of brushes, each pair in diametrically opposite positions. The number of subdivisions of the armature is so determined that the short circuiting brushes always cut in or out some of the divisions, and still no sparking occurs.

The field magnet cores are built up of soft iron sheets insulated from each other. In order



GUTMANN'S ALTERNATING MOTOR.

to facilitate the winding each of these iron laminæ is cut in two parts by a horizontal division line.

In this manner the field coils may be wound first, and then the two parts of the core may be inserted respectively from above and below. The whole arrangement is then held together by two bronze spiders, whose centers contain bearings for the armature shaft. The cuts are reproduced from *Elektrotechnischer Anzeiger.*

The Book Table.

THE ELEMENTS OF DYNAMIC ELECTRICITY AND MAGNETISM. By Philip Atkinson, A. M., Ph. D. New York. D. Van Nostrand company, 1891, 5x8 inches, 405 pages. Price, $2.00.

The book is intended for "learners rather than for the learned," according to the author. In a work intended for this class of readers it is not too much to demand accuracy, yet there are many grave errors in the book which cannot but mislead the learner. This is especially true of the chapters on "Dynamo and Motor," "Relation of Electricity to Heat" and "Relation of Electricity to Light." A few references will illustrate the general tone of the work:

The true ohm according to latest researches is represented by a column of mercury 106.3 centimeters high, not 106, as stated on page 6.

Again, on page 32, the word "intensity" is used instead of "tension" or "pressure."

Simple algebraic formulæ can be understood by anybody who has had a common school education, and students and learners, or in fact anybody who wants to "read up" on electrical matters, cannot do without them. We think it bad policy to convey the idea that anybody can study electricity without the knowledge of the rudiments of mathematics and algebra. The author commits the grave error of excluding mathematical formulæ in the introduction, and using them in the text. On page 5 he devotes, for instance, nine lines to state Ohm's law $C=\frac{E}{R}$, while we find on page 42 the formula $F=\frac{H}{\cos\theta}$

We think that if a reader can be made to understand the latter formula he might also grasp $C=\frac{E}{R}$. Here is another "simple formula" found on page 57: $P=a\sqrt[3]{w}$. There are three algebraic formulæ on page 115, and on 120 to 125 such terms as "measurements of angles," and words like "cosine" and "sine" are frequently used. On page 197 the reason for using series motors on street cars is thus explained:

"The shunt wound motor has the advantage of its special automatic internal regulation, while the series wound, having larger wire in its field magnets, is less liable to damage when employed on street cars; but as the response between the varying load at the motors and the application of power at the stationary engine cannot be made perfectly automatic, the necessary synchronism for this class of work is difficult to establish with the series wound machine." These who labored under the delusion that the series motor was employed for street car service because it allows of easy hand regulation, is easily reversible, can exert its full power at varying speeds, etc., etc., will, no doubt, realize the importance of Dr. Atkinson's disclosures. On page 204 the electric street railway system is thus explained: "As the direct current is usually employed, it enters by this wire (trolley wire), insulated in the air and returns by a brush, or other sliding or rolling contact with a wire placed in a conduit between the rails, the insulation of this wire being of less importance."

On page 254 the author once more yields to temptation. Here we find: $H=C^2 Rt\times 0.24$.

There are many other errors and inconsistencies, but those already noted will serve to show the general character of the book. It contains little valuable information, merely a jumble of facts, many of them stated in such a way as to be misleading.

ELECTRICAL TRADES DIRECTORY AND HAND-BOOK. Published by the Electrician Printing & Publishing company, London; 729 pages, royal octavo; price, 5s.

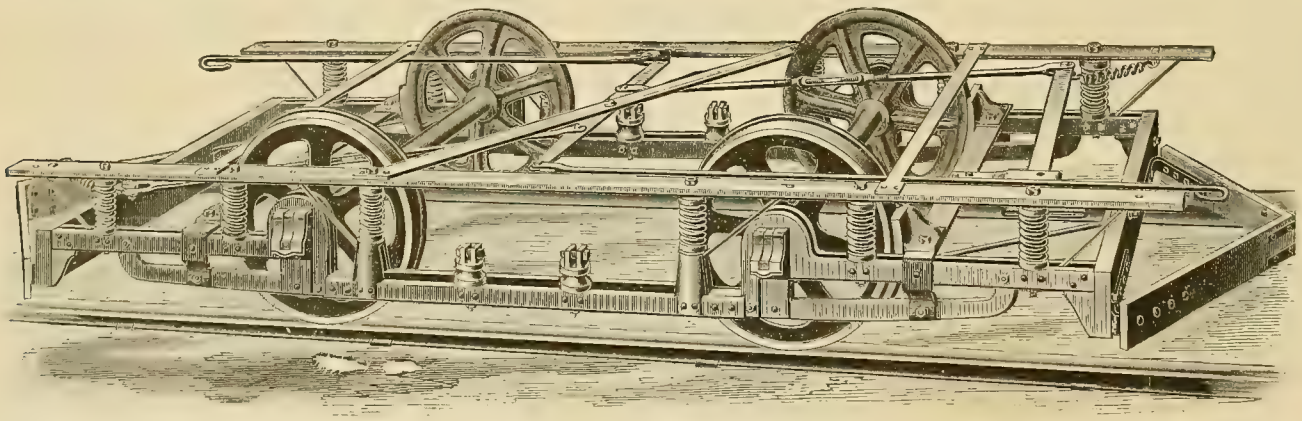
As usual, this book is filled with interesting matter and valuable information. As indicating the advance in electrical interests it may be mentioned that the present work contains over 100 pages more than the last edition, and 300 over that of 1889. The features which have made this work popular both in Great Britain and America are retained in the present number, and there are others equally interesting. The book contains notes on laws regulating electric lighting, a list of central stations in the United Kingdom, a list of electrical railways and tramways, a summary of the leading electrical events of the past year, information relating to obtaining patents, a complete list of the local authorities of England, and a biographical section, containing interesting sketches of prominent electrical engineers.

AMERICAN ELECTRICAL DIRECTORY. Published by the Star Iron Tower company, Fort Wayne, Ind.; 600 pages; price, $5.

This book is certainly creditable as showing the advancement that has been made during the last year. In addition to the list of central stations for light and power there is a list of isolated plants, though certainly incomplete, as the publishers admit. There are classified lists of electrical associations, clubs and societies. There is considerable general information and valuable rules relating to the insurance of electrical plants. The work is interesting throughout, and valuable to all engaged in electrical work.

Robinson's All Steel Electric Car Truck.

In the truck shown in the accompanying illustration the car body is supported at the extreme ends by springs, no less than a dozen being used. The steel yokes in which the journal boxes ride are braced below the boxes with equalizing bars, and the car wheels may be removed and replaced without disturbing the car body or brake mechanism, by simply removing a bolt at each end of the bars. The brake can be applied from either end, all of the wheels being gripped simultaneously. The brake bars slide on the rigid side frames and grip the wheels at the same point, regardless of the weight of load. The brake mechanism lies close up against the car body and does not interfere with the motor. The truck is so designed that the motor or its armature can be easily removed without disturbing the car body or brake mechanism, thus making all the electric parts readily accessible. The construction is such also that the truck may be used with the new gearless motor as well as with the old style motor. This truck was designed by C. M. Robinson of Altoona, Pa.



ROBINSON'S ALL STEEL ELECTRIC CAR TRUCK.

Trolley Wire Insulator.

The insulator shown in the cut presented herewith has just been placed on the market by Seibert & White of Allegheny, Pa. The device is extremely simple in construction, consisting merely of a bell-shaped insulator proper provided with a wrought iron saddle. This insulator is treated with a peculiar compound and has it is stated, stood the test of a four thousand volt alternating current without any leakage whatever. The Pittsburg and Birmingham Traction company is now using these insulators.

Chicago Electric Club.

At the next meeting of the Chicago Electric club, May 25th, a paper will be read by Prof. H. S. Carhart of the University of Michigan on "Armature Reaction in Constant Current Dynamos;" on Monday evening, June 8th, Prof. C. S. Cook of the Northwestern University on "Present Theories Concerning the Nature of Electricity." This will be the last paper of the season, and will undoubtedly be highly interesting.

TROLLEY WIRE INSULATOR.

The regular meeting of the club should have been held last Monday evening, but, owing to improvements that are in progress at the club, it was deemed advisable to postpone the meeting until next Monday evening, May 25th.

Since the club decided to abandon the restaurant service furnished by Kinsley the work of organizing an independent service has been vigorously pushed under the direction of the special committee, of which W. B. Pearson is chairman. The arrangements have now so far progressed that the committee is enabled to announce that the restaurant will be ready to respond to all demands made upon it by the middle of next week. A business lunch will be served from twelve to two, and dishes can be ordered at any time during the day or evening up to 11 P. M. It is earnestly hoped that the members will heartily support this feature of the club and insure its success by their attendance at lunch and at other times.

Of the two rooms in the rear on the third floor that have been utilized for the restaurant service, that nearer the hallway will be converted into a kitchen. Here will be a modern gas range with every imaginable convenience that could delight the heart of the most exacting *chef*, a large refrigerator and all the other necessary paraphernalia that go to make up the equipment of the cook's domain. The linen and china closet and the vault for supplies and provisions open into the adjoining room. It has not been fully decided as yet to what use this room will be put, but it will probably serve as a private dining-room.

The dining-room proper will be the same apartment as that devoted to a similar use during the Kinsley regime. A large and hand-

some sideboard of oak will be added to the furniture of the room, however, and will contribute not a little to enhance the cheerfulness and general appearance of the room. The small wine room opening into the dining-room will contain a reserve supply.

When completed, the restaurant service will, it is thought, be perfect in its details and an honor to the club. A competent cook and attentive waiters will be engaged to cater to the wants of the members, and there can be little doubt that the new feature will be popular and successful. Other improvements have also been made to increase the attractiveness of the club rooms. A fine polished hardwood floor has been laid in the billiard room, and the paper on the walls has been cleaned and brightened. Two card-rooms are to be fitted up on the lower floor, and altogether the club will soon boast of better accommodations amid more attractive surroundings.

Edison's Visit to Chicago.

The visit of Thomas A. Edison to Chicago last week and the cordial interest he manifested in the Electrical Department of the World's Columbian Exposition will undoubtedly do much to strengthen the position of the electrical interests of Chicago in relation to the arrangements now making for the electrical exhibit at the World's Fair. The famous inventor heartily indorsed Chief Barrett's course and expressed his conviction in positive terms that the head of the electrical department was well qualified for the duties devolving upon him. He was equally certain that the exhibit should be united and not divided among other departments, and cited his experience at the Paris Exposition of 1889 in support of this point. Mr. Edison talked freely on the subject to the gentlemen he met, including a number of eager reporters, with the result that his views became widely known in a short space of time. The fact that the weight of Mr. Edison's recognized influence was thrown so heartily and unreservedly in favor of the Department of Electricity, in the latter's demand for adequate provisions for the electrical display, can not fail to be of great assistance to the department in the future. The exposition authorities will hardly care to disregard the opinion of the man who made the most attractive and popular exhibit at the Paris Exposition, and who became the lion of the day in France.

Mr. Edison arrived on Tuesday, the 12th inst., and almost immediately plunged into business by taking up the plans now under consideration for extending the business of the Chicago office of the Edison General Electric company and the Chicago Edison company. He was a very busy man all day, but managed to find time to talk to a party of newspaper men. When questioned about the electrical exhibit at the World's Fair, he said:

"By all means the electrical exhibit should be united. At Paris the electrical exhibit was so scattered that one had to walk fifteen miles to see it all. Of course the exhibit will be a grand one, however it is arranged, but the effect will be best if it is all together. Oil may be used for fuel, so that no prospect of a smoke stack on the grounds need frighten those who have it in control. As to conveying steam from boiler houses 1,500 feet from the engines, that would prevent any tests of the power-producing qualities of a certain amount of fuel. By placing dynamos in the power house and conveying the power to the electrical exhibit by wires, that trouble would be avoided, but others would arise.

"Prof. Barrett is a first-rate man for chief of the department. He is an electrician of sound sense and will get a good exhibit; but all the exhibits will have to be cut if the building is to be only 700 by 350 feet. At Paris I had about one acre for my exhibit and there were about twenty thousand people around it all the time. Everything there was done entirely for glory—here there will be a commercial interest in it. The Paris display cost me about $70,000 and everything was free. Every one had a chance to listen to a phonograph. I had thirty assistants there all the time. Here it will not cost nearly so much to exhibit, so I can make a much finer display for the same total expense."

Speaking further on the subject Mr. Edison returned to the power question, and said: "The transmisson of electrical power from the machinery annex to the electrical building will prove unsatisfactory. The conductors will get out of order and the ground will have to be torn up to make the repairs. If there are twenty different exhibitors there will have to be several times as many tearings up. Then the Fair Commissioners will get tired and say the thing will have to be stopped. The exhibitors, on the other hand, will complain that they are not being fairly treated, and there will be dead exhibits. If the exposition company should attempt to make arrangments for conducting the power, any and all accidents would be charged to the company. The right way to do is to place the power in the same building with the exhibits. At the Centennial an attempt was made to do something similar, and when the authorities were ready to start the machinery it would not start.

"It should not be too late to make a change in the building now, but if it is, why, a division of the exhibits in two parts would be much better than a dozen as at Paris. I have heard there was a movement to split up the electrical exhibit, and I have thought the management should be careful. The desire to make money out of everything is strong in this country, but there should be some patriotism exhibited in the management or conduct of the exposition. The commercial spirit should be kept out as far as possible."

On Wednesday Mr. Edison was taken up to the offices of the Construction Department of the World's Fair. He expressed great admiration for the beautiful design of the grounds, which was explained by Frederick Law Olmstead, the landscape gardener. He repeated, however, his expressions of disapproval of the project of conveying power 1,500 feet from the machinery annex. Mr. Edison told Mr. Burnham that the electrical building had evidently been designed by an artist rather than by an electrician. He also emphasized the fact that the exhibit should be a united one. To Prof. Barrett Mr. Edison said: "Don't under any circumstances let them divide this exhibit for you." Prof. Barrett then suggested that it might be insisted upon. "If it is," was the reply, "you'd better let them divide it for some one else. You cannot afford to keep charge of an exhibit that would be a partial failure."

At luncheon Mr. Edison met Prof. Barrett, Frederick Sargent, consulting electrician for the Construction Department, Secretary Hornsby of the Department of Electricity, and W. A. Kreidler of the WESTERN ELECTRICIAN. A pleasant social conference was the result. The *Inter Ocean*, following its usual practice of doctoring the news to suit its own ends, announced that Mr. Edison advised Prof. Barrett, at this meeting, to cease his opposition to the plan for dividing the electrical exhibit. Quite the opposite was true, of course, Mr. Edison expressing himself as strongly in favor of a united exhibit and more room. He said that if a united exhibit was decided on, he himself would take two acres of floor space, or more than one-quarter of the total provided by the present arrangement.

The distinguished visitor told the reporters that he was working on a new electrical invention to be known as the kinetograph. It appears to be a device for reproducing photographs of moving objects on a screen at a distance from the scene portrayed at the time the event is transpiring or at a later date. Mr. Edison is reported as having given this description: "It is an instrument that does for the eye what the phonograph does for the voice. It will register the looks and gestures of any person and then reproduce them at any future time and place. By combining this with the phonograph a man may be seen and heard at the same time, and speeches, plays and scenes may be reproduced at will. I can place one so it will command a street corner and after letting it register the passing sights for a time I can have it cast them on a canvas so that every feature and motion of the passers, even to the twitching of the face, can be seen, and if a friend passed during the time you may know it. One that I have now in my laboratory reproduces the scene of a prize fight, and shows every blow and motion. But the invention is rather of sentimental than commercial value. In my laboratory I have men at work on two other special and new inventions, which are not yet ready to be announced."

Thursday was spent by the Edison party in Michigan, where the inventor is largely interested in iron mines.

President Baker and other members of the local directory of the World's Fair having expressed a wish to meet Mr. Edison, Prof. Barrett and Secretary Hornsby arranged a meeting for Friday morning. By a previous arrangement Chief Barrett and his secretary met Mr. Edison and Mr. Insull, the vice-president of the Edison General Electric company of New York, at the Chicago Edison station, and the four proceeded to President Baker's office at the World's Fair headquarters. Here Vice-president Bryan also joined the party, and later Treasurer Seeberger dropped in. The gentlemen had a pleasant chat, and Mr. Edison gave the directors many "pointers" in relation to the Paris exposition of 1889. Curiously enough, however, the subject of electricity was not mentioned. Mr. Edison left for his home in the East Friday evening.

Many of the Chicago papers made editorial reference to Mr. Edison's presence in town and urged the necessity of heeding his advice in relation to the electrical department of the World's Fair. Said the *Post:* "Private interests are said to have brought Mr. Edison hither, but that fact does not block a very general interest in Mr. Edison's presence. The less so, as Mr. Edison is known to take a keen and intelligent interest in the World's Fair, and especially of that department to be devoted to electrical science. As we are informed, the great inventor is quite in accord with Professor Barrett as to the latter's views of the extent of space that will be required for a proper display of the electrical exhibit. Being a man of extensive views himself, and feeling more or less interest in the general subject of electrical science, Mr. Edison would like to see the electrical exhibit at the Columbian fair as complete and nearly perfect as possible. If it is to be of this character it must have room. The directory, we are certain, will appreciate the value of Mr. Edison's judgment in the matter." The *News* also had an enthusiastic editorial on the same subject.

Bellamy's Municipal Lighting Scheme.

Edward Bellamy just now is devoting most of his attention to the subject of municipal ownership of public works. His journal, the *New Nation*, is constantly harping on this topic and his followers are urging their claims on the Massachusetts legislature. In a recent number a writer presented the following argument on the legality of the project:

"If it is unlawful for cities and towns in Massachusetts to light their streets with gas lights why isn't it unlawful for them to light their streets with oil lights? My old town of Groton, Mass., has for years been doing the latter. Has it been doing wrong? But I suppose the gas fellows would say in the latter case the streets were not torn up to lay pipes, etc. But who owns the streets any way? I can't see, if the people of a town prefer to light their streets by new instead of old fashioned methods, why they (all of them) should not have as perfect a right to, as a few of them."

Mr. Bellamy handles the subject editorially in this way:

"The joint committee on manufactures in the Massachusetts legislature has reported bills granting special permits to five or six towns to manufacture their own gas and electricity. This is understood to be the outcome of a conference of Republican leaders to meet the popular demand for municipal ownership. It is agreed by old hands at politics that it will not do to go into the next campaign handicapped by a blank refusal to listen to so reasonable a demand. But are not the Republicans weak in their programme? In allowing one town to buy a gas or electric plant do they not admit the principle for which all good Nationalists contend? It seems to us that this, the latest move of the Republicans, is the best kind of an argument in favor of a general statute under which any city or town can vote to buy, own and run a lighting plant."

The Nationalists are fighting the West End Street Railway company of Boston in its efforts to secure immunity from taxation in consideration of the rapid transit facilities it stands ready to give the city as soon as the pledge is given.

Bellamy's scheme involves the problem of life tenure of office. In a recent editorial the New York *Sun* touched upon the subject as follows: "The experience of government is that life tenure of office generates a bureaucratic spirit, obstructive to progress, stiff-necked, ultra conservative, opposed to all changes of routine, stagnant, jealous, arrogant and narrow-minded. This spirit is manifested

strikingly in our army and navy services, and more especially in the staff departments, which are stubborn in their opposition to all improvements not devised by themselves; and their secure tenure of their places stifles in them the inventive faculty and the ambition of progress. In what private business is the life tenure adopted as a principle? In what one are the employed free from the chance of dismissal at the will of their employers?"

Electrical Execution Law.

The execution of the death penalty law in New York is a task of no mean proportions nowadays. The latest turn of events was the action in the Wood case. When the appeal to the Supreme Court was decided adversely counsel for the condemned man announced that the fight had just begun. He said:

"As I understand the decision of the Supreme Court, it would have granted the habeas corpus asked for in Wood's case if the action had been taken early in the proceedings, and further that the defendant waived his rights by silence until after his trial and conviction. The point involved was Wood's right to represent his race and color upon the grand and petit jurors which convicted him.

"Under the law Wood must practically be resentenced. Then he is allowed at least four weeks in which to prepare for death. However, I will take another appeal in his case. I propose to test the constitutionality of the law for execution by electricity. If I live Wood will not be executed this year, and in 1892 I shall appeal to the recorder for a new trial on account of newly discovered evidence." In other words, Attorney Haire will keep on appealing and his client will evade the death penalty until there is more legislation concerning appeals on trivial points in the cases of convicted murderers.

One of the points raised in the Jugiro appeal was that there were no Japanese on the jury which convicted him. Mr. Haire said that this feature was stolen from the Wood case and was nonsensical as applied to the "Jap."

Warden Brown, Sing Sing prison, said that he would have nothing to do in the matter till the court ordered him to bring any one of the condemned murderers to New York to be resentenced.

The present condition of affairs in New York has provoked this comment from the New York *Sun*: "Probably there never will be any executions in this state for the crime of murder in the first degree so long as it is possible for a convicted murderer to secure a stay of proceedings as a matter of right upon an appeal to the Supreme Court of the United States from an order of a federal judge refusing to release him upon a writ of habeas corpus. As the law has thus far been construed by the federal judges in this city, the appeal which they are bound to allow under the act of Congress operates of itself as a stay."

The Supreme Court of the United States has just announced decisions in four New York murder cases, and in every instance the action of the trial court has been affirmed. In the telegraphic summary this statement occurs:

"The court, in two opinions by Justice Harlan, intimates quite plainly that there has been too free a use made of the writ of habeas corpus by the New York Circuit Court, and states that, where there is no conflict between the State law and the federal jurisprudence, the highest state tribunal should determine the points raised, and any appeal should be direct from the state court to the United States Supreme Court by writ of error."

Unless an examination of the language of Justice Harlan shall show a practical condemnation of the present procedure, there will probably be no relief from the existing condition of things until Congress meets in December and changes the law relative to appeals in habeas corpus proceedings.

Scarcity of Gutta Percha.

As everybody knows, gutta percha has hitherto been largely used as an insulator for submarine cables. But manufacturers are confronted by the fact that the supply is so limited that the price is now $1.75 per pound, and will undoubtedly go higher.

Gutta percha, like platinum, is a material that has increased in price as the use of electricity has become more and more general. Caoutchouc has been proposed as a substitute. But authorities agree that while Para rubber is a good insulating material under ordinary circumstances, it cannot withstand the forces that attack it at the bed of the ocean. Balata has also been suggested, but it is said it cannot be secured in sufficient quantities. There is also said to be a gum on the banks of the Orinoco which makes an insulating material almost as good as gutta percha, but it is not found in commerce. Gutta percha, which bids fair to be a more important article in the market than ever before, comes through England from the Malay Peninsula, India and China. Four-fifths of the entire product is used in making cables, and nine-tenths of it is handled in England. That which is exported to this country is oftentimes only the refuse from the British shops, boiled over and remoulded.

The constant diminution in the supply of gutta percha is explained by an importer in this way: If a Malay or Chinese wishes to plant pepper or anything else, he burns down a portion of the forest, and when he has raised two or three crops he clears a new portion. Thus, finely wooded spots become denuded of trees and covered with rank grass, rendering them unfit for further cultivation. Again, to obtain the gum, the trees are cut down, none are planted to take their places, and the result is that in districts where percha trees once abounded only one or two can now be found. A writer in a contemporary says that in twenty years over 90,000 piculs (of 133⅓ pounds each) of gutta percha were exported from Sarawak alone, and that this meant the death of at least 3,000,000 trees.

The Manchester, England, corporation thinks of lighting the central portion of the city by electricity.

Production of Mica in the United States.

Manufacturers of electrical apparatus will be interested in the official returns made to the census department by the division of mines and mining on the subject of the production of mica in this country. Operations were confined to the states of New Hampshire, North Carolina, Virginia and South Dakota, in the order named, and the production amounted to 49,500 pounds of cut mica, valued at $50,000. There were also 196 short tons of scrap and waste mica utilized for grinding purposes, with a value of $2,450. The expenditures for the entire product amounted to $45,425, distributed as follows: In wages, $34,292; for supplies, $6,103; other expenditures, $5,030. In addition to this there was expended in the development of mines at which no mica was produced a total of $12,910, as follows: In wages, $7 882; for supplies, $1,305; other expenditures, $3,723. The capital invested in the industry was $691,550. The production in 1880 was 81,669 pounds, valued at $127,825.

According to the bulletin issued by the census department there was considerable fluctuation in the annual production between 1880 and 1889. For five years there was a marked advance, then the tendency was downward, the lowest point reached being in 1889. Only once did the industry rally, in 1887, when the value of the production was $142,250, as against $70,000 the previous year. It immediately fell back, however, to the point reached the year before, and the next year showed a still farther decline of $20,000.

The year 1884 marked the most prosperous period of mica mining in this country. In that year there were 147,410 pounds of mica produced, the value being $368,525. During the years 1883 and 1884, when mica mining was in its most flourishing condition, the manufacturers of stoves consumed probably 95 per cent. of the product, and the fancy grades and large sizes of sheet mica which were then used found a ready sale at highly profitable prices. Under this stimulus of large profits many surface deposits or pockets were opened by farmers or other individuals of small means, who worked them occasionally when other business was dull and realized a considerable profit on their production. As long as the demand for large sizes continued this intermittent sort of mining could be carried on with a degree of success, but not when small sheets were in demand. When the demand changed from large to small sizes the majority of miners were unprepared, through lack of capital or for other reasons, to adopt such methods. The result was a great reduction in the number of producing mines, and consumers were compelled either to raise the price of mica or look to foreign sources for supply. Another factor in increasing importation came into existence with the extended manufacture of dynamos and other electrical apparatus, in which a great deal of mica is used. The foreign article, especially that produced in Canada, was, on account of its superior cleavage, preferred to the domestic for this purpose, but since miners have become more fully acquainted with the qualities desired for electrical uses it is claimed that the United States can produce mica for this purpose equal to any found abroad. The foreign supply, after gaining a foothold in American markets, has more than held its own, and as its tendency has always been toward a reduction in prices there has been little inducement for the outlay of capital in mica mining.

Only a small number of mines were operated in 1889, and few of these were worked steadily throughout the year. However, there was a fair amount of development work done in the different mica regions, and it is expected that the introduction of more systematic methods of mining will greatly increase the importance of the industry. The greater part of the output in 1889 was taken from one mine in New Hampshire. Of the North Carolina mines none were in steady operation throughout the year, and the production of that state was the result of irregular and spasmodic efforts. In Virginia the production was confined to one mine, located at Amelia Court House, which was exhausted early in the year. In the Black Hills region, where in 1884 eleven mines were operated, with a production of over 18,000 pounds of mica, only one produced in 1889, and that only a small amount. In New Mexico a good deal of development work was done and a quantity of good mica was reported as taken out; but none of this was marketed.

The men employed at these mines numbered 185 and their wages amounted to $42,174, but of this number only a small proportion were steadily employed throughout the year.

Rapid Transit in American Cities.

One of the chief advantages of the electric street railway is the high rate of speed attainable. The importance of this is appreciated by American business men generally. There are, occasionally croakers, however, who complain that the increased speed necessarily means increased danger, but this view of the situation does not appear to be sustained by the facts.

The question of regulating the speed of electric cars in Rochester, N. Y., it is stated, will be brought to the attention of the common council of that city.

Commenting on this the *Herald* of that city says: "Whatever concerns the safety of the public is a legitimate topic for the consideration of the council. It is possible, of course, to run the electric cars at too high a rate of speed for the crowded streets of a city. But we do not think that has yet been done.

"It doesn't follow that there will be no accident if the speed of the cars is reduced. Probably there will be just as many as we now have. If the council could legislate a little more caution into the minds of the people, that body would accomplish what is desired. We have witnessed scores of careless and reckless acts in the presence of the electric cars that would have had serious results if it had not been for the promptness and energy of the motor men.

"There is no use of talking about greatly reducing the speed of the cars. Rapid transit is what the people want and must have. Thousands live from one to two miles, or over, from the heart of the city and their places of business. The question of time is an important one to them. At the present rate of speed of the cars they save from five to fifteen minutes every time they make the trip, or from twenty minutes to an hour a day. The loss of even half that time is a serious matter to busy men.

"We believe there is no call for reducing the speed of the cars. The public will soon be educated to observe reasonable care, and accidents will be comparatively few. Some casualities would occur if the cars were drawn by oxen, as they did when all were drawn by horses. They are unavoidable in crowded communities, and though deplorable, should not be permitted to interfere with the employment of means and methods essential to the best interests of the people at large."

Powers of Municipal Government.

The first annual banquet of the Advance club of Providence, R. I., was the occasion of an elaborate address by the president, D. M. Thompson, on municipal government. The speaker was thoroughly imbued with Bellamistic thories, which he commended as follows: "The tendency of the age is very strongly toward increasing the functions of our governmental organizations, municipal, state and national, by assuming the administration of those services which affect the common welfare, and which can be more efficiently conducted by associated action than when left to each individual to provide for himself. It is an admirable tendency, and the application of the principle involved is limited only by expediency. When a community once learns that it can obtain a better service by public administration, it will naturally not be slow in carrying its lesson into effect."

Continuing in this strain, the speaker said: "There are few who to day have the hardihood to deny the greater utility and economy of publicly owned waterworks, and the time can not be far distant when the idea of the public ownership of gas and electric light works will find correspondingly few to object. Indeed, I believe that in the comparatively near future the custom of the municipal ownership and operation of street railways will become as firmly established as that of a public water supply now is.

"As to the advantages of public administration of a municipal lighting supply the evidence is so abundant on every hand, both in this country and abroad, as to call for no specific citation here."

Mr. Thompson is not unlike other theorists. He is impatient at any opposition to his plans and appears unable to appreciate the fact that there may be honest opposition to his pet hobby. "At every proposition to step forward in these directions we are confronted by the same sort of opposition. A few months ago, at a meeting of electricians here in Providence, the attorney for the Massachusetts Electric Lighting association called the efforts to secure for cities and towns their right to do their own lighting an insane agitation."

This greatly incensed the learned president of the Advance club and he proceeded to dispense flapdoodle with a lavish hand: "When I characterize such language as insolent, it is with no disposition to reflect upon a personally most estimable gentleman, but with the same liberty of expression which, as an attorney, he allows himself in the exercise of his professional duties, I confine the characterization of the attorney's utterance, trusting that no true American citizen can so far forget the origin of his country's independence as thus to regard the righteous effort of a people to secure emancipation from the payment of taxes arbitrarily imposed by the private possessors of a public service. If this be an 'insane agitation,' then it is decidedly a madness with a method. Against the granting of this right is raised the plea that it is an interference with the sacred prerogatives of private enterprise, but when private enterprise takes that shape and assumes the privilege of taxing a free New England community as it may choose, for administering a public service which it alone claims power to render, forcing an unwilling community to yield it tribute, then I can see no difference between this claim and that of King George III., which our forefathers so successfully resisted."

Mr. Thompson expresses the belief that the adoption of his project would tend to elevate the tone of American politics, and in his explanation of the dealings in which the city officials and managers of public works are concerned he presents this unfortunate illustration: "There is nothing like a concrete example, and therefore I will cite the experience of a gentleman who is in charge of the practical work of one of the great corporations that renders a public service in Boston. Desiring to use a certain device which he knew to be the best for the purpose, he submitted it to a certain city official, now happily no longer in office, for approval, as required by law. 'No, I cannot approve that,' said the official.

"'Why not? It is the best!'

"'That makes no difference,' responded the official. 'You must use my device.'

"The official was the proprietor of an invention devised for the same purpose, and, on his appointment to office, to evade the law he had nominally transferred to another party his title thereto. Therefore the company, in order to do its work, had to stand in with a city official or be seriously hampered. The company did not pay the city a cent for its valuable privileges in the streets, but it paid large tribute to a city official, in the shape of using an inferior device in the place of a more efficient and less expensive one."

And these are the men in whose hands it is proposed to place the management of public enterprises!

Telephone subscribers increase rapidly in Melbourne. In 1889 they numbered 1,670, and the receipts were £25 236; in 1890, 1,903, and the revenue was £29,000.

Industrial Uses of Electricity.

The general interest manifested in the advancement of electrical industries is evidenced by the attention given the subject by the newspapers of the country. In a recent issue the *Chicago Herald* editorially said: In 1880 the extensive use of electricity to drive machinery was hardly thought of by most people, and was regarded by electricians, with perhaps a few exceptions, only as a possibility of the future. In the United States census of that year the subject of power employed in manufactures was introduced, but the reports dealt only with steam and water power, and electricity was not mentioned. Some two years ago a New York paper gave a list of one hundred and fifty industries in which the electric motor was used, and an editor of that paper has recently expressed the opinion that this motor is now used in connection with nearly three hundred branches of industry.

In view of what has been accomplished in so short a time we may reasonably regard electricity as the coming power in most industries and in all where distribution of power to many machines is desired and where the very highest power, as for steamships and large waterworks, is not required. It is already employed in the driving of street cars, and men like Henry Villard are expecting it to supersede steam as the motor on all the railways of the country.

Hitherto the cost of generating electric power has stood in the way of its extensive employment. It is a secondary power, produced by the application of steam or water power, and the conversion of one into the other necessarily involves some loss. This is of comparatively little importance where there is an abundance of water power as the primary agent, but where fuel must be consumed the loss is serious. But improvement in the process of combustion of cheap grades of coal is the problem which is engaging the attention of many able and ingenious experimenters and there are prospects of a solution resulting in great economy as well as exemption from the smoke nuisance. When this solution is reached the loss from conversion of steam power into electric will be too small to be considered where division of power, economy of space and convenience of application are important desiderata.

The introduction of cheap electric power will work industrial changes as great as any of which Edward Bellamy has dreamed, and without any of his visionary social and economic arrangements, and with a most distinct gain, instead of loss, to that individualism which is the source of progress and life in modern society. When power can be brought into every little shop, into every house in the cities, towns and villages; when operatives, instead of being crowded into ill-ventilated factories, can to a great extent do their work at their homes, not only social but sanitary conditions will be greatly improved, and a new impulse will be given to mechanical invention which will be worth uncounted millions to the world.

Already the electric motor has been used to run the sewing machines of girls employed in glove making in their own homes, with the result that the girls do more and better work in less time and with less fatigue, while there is a marked improvement in their health. This fact serves faintly to indicate what may be expected from electric power after its general introduction.

American Institute of Electrical Engineers.

At the last meeting of the American Institute of Electrical Engineers the secretary read the following obituary of Thomas P. Conant:

"Thomas P. Conant was born July 11, 1860, at Paris, France. He was carefully educated and graduated at Columbia College School of Mines, as a mining engineer, in 1882. He then became Mr. Edison's secretary, and subsequently served in the construction department of the Edison company, where he continued two years. He gained further electrical experience with the United States Illuminating company and the Bradley Electric Power company After an engagement of one and a half years with the Electrical Accumulator company, he re-entered the Edison service in August, 1889, and was appointed engineer of the eastern district of the Edison General electric company, a position which he occupied at the time of his death, which occurred on February 24, 1891, at the home of his grandfather, Rev. T. J. Conant, in Brooklyn. Mr Conant was elected an associate member of the American Institute of Electrical Engineers, November 1, 1887, and was transferred to full membership January 3, 1888. He was also a member of the American Society of Mechanical Engineers, the Electric club, the Manhattan Athletic club and other associations. In his leisure moments he devoted much time to literature, and several poems from his pen have appeared in *Harper's Magazine* and other periodicals. He made several improvements in secondary batteries and their applications, patents for which were assigned to the Electrical Accumulator company."

Electrical Department of the McGill University.

The new buildings of the department of applied sciences of the McGill university are nearly completed, and the faculty announces they will be ready for occupancy in September. Five distinct departments have been established by the faculty in which courses of instruction are especially arranged for students entering the professions of civil engineering and surveying, mining engineering, mechanical engineering, electrical engineering, practical chemistry.

The equipment of the electrical engineering laboratory includes a high speed steam engine coupled directly to a dynamo for incandescent lighting and a slow speed steam engine for driving the experimental dynamos. These latter have been chosen to represent the best types now in general use, both of high tension and low tension direct current dynamos, with various methods of winding, and also of alternating current dynamos of low tension, and of high tension for use with transformers.

Arrangements have been made for measuring the mechanical power supplied to the dynamos and given out by the electric motors, of which there are several types; these arrangements comprise various forms of belt, rope and transmission dynamometers, with an excellent form of hydraulic absorption dynamometer, with which the accuracy of the others can be checked by readings in absolute measure. The well-known form of cradle dynamometer, for dynamo testing, of course, finds a place here, and special facilities are provided for varying the speed of the dynamos within any required limits.

The instruments for making the electrical measurements have been selected with much care. These instruments will enable measurements of current resistance and difference of potential to be made with great accuracy, not only in the detached laboratories but in the dynamo room when the machinery is running. In separate rooms there are standard instruments of extreme precision with which the correctness of the working instruments can be readily checked. These include two of Sir William Thomson's electric balances. There are also a variety of instruments for special purposes connected with electrical measurements, such as instruments for determining coefficients of self and mutual induction.

An English Dentist's Experience with Electricity.

In the London *Electrical Engineer* of a recent date is given an amusing account of the manner in which an enterprising English dentist—H. Fielden Briggs by name—who also dabbles in electro therapeutics, made himself a martyr to the cause of science. He had seen an account of a new electrical method of extracting teeth by which the sensation, so far from being painful, was said to be rather pleasant than otherwise. Living in Torquay, he determined to go up to London and test the new method, by which he seems to have been favorably impressed. When he returned home, however, he had a grievance, and, being an Englishman, he aired it by writing to the local paper. This is his story in his own words:

"Not having a decayed tooth, I resolved to sacrifice a sound one, believing practice to be better than theory. I was referred to the surgery of a qualified dentist, when the performance began. The instrument, in order that the armature should vibrate 452 times to the second, was tuned up to A, and emitted this note during the operation. I was seated in the chair holding in both hands the handles from a battery. The current was sent through me until I could bear it no longer, when it was stopped temporarily. The forceps, also connected with the battery, were adjusted to the tooth. The current was then turned on through the tooth and at the same time through the handles, which I still held, during which time the tooth was extracted and the current then stopped. During this process the sensation to me was like being the central figure at a miniature execution by electricity, for I not only felt the pain of the tooth, but also pain about the head and face and up the arms. This was combined with the helpless feeling of not being able to let go the handles while the current was turned on. After it was over, on my saying it had hurt a good deal, the dentist replied, 'With due deference to you, I must say it didn't.' I then intimated that I was more likely to be the better judge of that. I have had teeth taken out painlessly by the aid of the recognized anæsthetics, and one without any pain obviator, which of course was painful, but not nearly so unendurable as the one removed by the assistance of the so-called electrical pain preventer. The latest instrument is no better than its predecessor. If any one doubts this, let him go and try it for himself."

Electric Railway in Rochester, N. Y.

It is certainly encouraging to note signs of appreciation on the part of the public and the press in relation to electrical enterprises. In a recent issue the Rochester, N. Y., *Herald* makes the following allusion to the electric railway system installed in that city by the Short Electric company:

"A delegation of business, railroad and newspaper men from Fall River, Mass., will visit Rochester to-day for the purpose of inspecting our new electric railway system. They will find several lines in full operation and others nearly ready for the starting of the electric cars. There can be no question that they will be pleased with the workings of the system, for nothing equal to it in all respects in the line of street railways of which we have any knowledge exists in the United States. There are electric railways in many cities and many new ones are building, but the Rochester system unquestionably is unique in the thoroughness with which it has been constructed and the excellence and elegance of the cars. It will be difficult for strangers to appreciate, as citizens who watched the construction of the system can, the fine and substantial work done in preparing the road bed and in laying the rails. They cannot fail, however, to notice the smooth running of the cars and the general excellence of the entire service. Inspection and conferences with our citizens must also satisfy them that the trolley system, while it has its imperfections, is not as objectionable as critics in other cities, notably New York and Brooklyn, where it meets with much opposition, suppose. The success of its operations depends upon the excellence of the materials employed and of the work done. Rochester has been fortunate under the enlightened management of the company here in having the best that money could command, and no impartial observer can question the general success of the system here. The electric railway constructed and run under such auspices is incomparably superior to the old horse railway and, we believe, far more desirable than the cable system. Deplorable accidents, of course, will occur under any system, sometimes through the fault of employes and in other cases through the carelessness or recklessness of citizens. But by exercising due vigilance and caution the number of such casualties will not be much if any, greater under the new system, with all its advantages of greater speed and comfort, than under the old one."

English Telephone Service.

An English electrical paper says: "In no town or city on the continent or elsewhere is the telephonic service so utterly bad and inefficient as it is in London, and for this commodity, or rather for this nuisance, the National Telephone company charges £20 per annum. In the provinces a nearly uniform charge of £10 has at last been adopted, and why? Simply because the Mutual Telephone company threatens competition, and not only threatens it but has actually entered the field, and has made a successful start in Manchester. In London the National company thinks it is safe from such an unpleasant intrusion, for the difficulties encountered by a new company, would be very great indeed."

In speaking of the manner in which successful competition against the National company could be conducted, our contemporary continues: "The only way in which this could be done would be to form an influential committee with a view of securing the adhesion of the largest possible number of business and private individuals to a project of an improved telephonic service in London. This project might either assume the form of starting a new company, or, for the sake of argument, of inviting the Mutual Telephone company to extend its operations to London. The difficulties in this case would soon vanish, for the number of subscribers to the National company's service—if it can be called a service—is not very large, thanks to its unceasing efforts in making its subscribers as uncomfortable as possible. London, with a population of four and a half millions, has only about 8,000 subscribers, and there can be no doubt that an equal number would gladly and at once avail themselves of the conveniences afforded by the instrument if they could make sure that they could now and then carry on a conversation without feeling inclined to consign the instrument, the operator, and the directors of the company to a place where wires are hot and safety-fuses of no avail."

Preparations for the Mid-Summer Convention.

The representatives of electrical interests in Canada are already preparing for the mid-summer convention of the National Electric Light association at Montreal. A meeting was held last week at which an organization was effected for the purpose of arranging for the reception and entertainment of the visitors.

Professor Bovey presided, and there were many prominent citizens present. The chairman, in calling the meeting to order, spoke of the great benefits to be derived from holding the convention in Montreal, and the pleasure it would give the citizens of Canada's metropolis to welcome such a distinguished gathering of citizens of the United States.

It was decided to appoint a citizens' committee, a reception committee, one on amusements, and others to be subsequently decided on. It was agreed that the citizens should secure as many attractions as possible, in the amusement line, during the visit of the members of the association.

It was stated at the meeting that the electrical exhibition to be held during the sitting of the convention would be the leading feature, and certainly be the finest ever held in America. So far as the attendance at the coming convention is concerned, it promises to be very large, and quite equal to that of any convention yet held by the association.

"So far as public opinion can be judged," says the Montreal *Herald*, "every one, the most prominent citizens included, are enthusiastic over the holding of the convention here, and claim that in every way it will be a grand success."

CORRESPONDENCE.

New York Notes.

NEW YORK, May 16.—Jay Gould appeared in person at the meeting of the Rapid Transit commission last Tuesday. His application for more than eighteen miles of new lines for the Manhattan Railway company was a surprise. Mr. Gould said that his plan would practically solve the rapid transit problem. He asked the commission to consider six new routes which he mapped out and explained in detail. It is proposed to ask only one fare, and passengers will be allowed to change cars at any station without additional fare. Mr Gould said that the company was co-operating with the bridge trustees, and would do its share of the work of extension of the bridge terminals in connection with the enlargement of the city hall station of the elevated railway. A third track would be needed on all the lines and the new structures would be built heavier so as to run trains at a greater speed. If Mr. Gould's great scheme should be adopted, electricity is destined to play an important part. The commission is in favor of electric traction, and Mr. Gould has said upon previous occasions that it is the intention of the elevated railway company to adopt the electric motor in the near future.

The act of the legislature legalizing the division of the contract for the building of the city's subways has given ground for the Board of Electrical Control to settle the big dispute.

At its meeting yesterday the privilege of building sub-

ways for low tension wires and the control of those subways already constructed for the wires of the local telegraph and telephone companies was awarded to the Empire City Subway company, limited. The Consolidated Subway company will continue to build the subways for the high tension wires. This ends the struggle which has been going on for years between the electric light companies on one side and the Western Union & Metropolitan Telephone, the Edison General and the Bell Telephone companies on the other. The mayor hauled the old company over the coals for the dilatory character of its work, and said that under the new privilege the company should promise to build subways more rapidly. Manager Ridgeway of the Consolidated company, protested that the company had 600 men at work.

"I'll bet a hundred to ten that you haven't," exclaimed Mayor Grant, and, pulling a note book from his pocket, he proved that he was right. Then President Lauterbach of the Consolidated said that they had already spent $5,000,000 in the work, and were hampered for lack of funds. Everything would go on faster, however, with the aid of the Empire company. He also hinted that if the members of the Consolidated company could agree among themselves, the Empire company might eventually secure entire control of the subways.

The incorporators of the new subway company are David R. Parker, W. T. Bouchelle, H. F. Stevens, J. C. Reilly and U. N. Bethell. Col. Parker agreed to provide a bond of $250,000 that the work of constructing the subways would be faithfully performed.

Judge Lawrence of the Supreme Court reserved decision yesterday on a motion to enjoin the city from removing the wires of the Electric Power company from the streets and housetops. It was contended on behalf of the company that it was authorized to maintain its wires until proper subways are provided; that there are no subways, and that the currents the wires carry are not dangerous.

John Doorley, a lineman of the United States Illuminating company, while taking down some wires on the Bowery on June 13, 1889, took hold of an improperly insulated wire and received a shock which upset his nervous system, bruised his back, and burned his hands. He brought suit against the company for $10,000, and recovered a verdict of $2,500 before Judge Dugro in the Superior Court yesterday.

Telegraph Lineman William Dix, of the fire department, is suing the city for $1,771 for salary, claiming that he was illegally dismissed February 13, 1887.

Martin A. Frank has sustained at least a temporary defeat in his fight against the Edison Electric Light company to prevent its consolidation with the Edison General Electric company. He asked for an injunction to restrain the company from consummating the proposed consolidation, and for a receiver of the Electric Light company.

The defense was that the light company still maintained its corporate existence and will continue to do so, and that its acts have not been illegal. Its stock has been transferred by individual holders to the General company for stock in that corporation. It is claimed that Frank was not a stockholder at the time of the alleged consolidation, and that the value of stock has been enhanced since that time.

In denying the application Judge O'Brien says that the granting of this motion would seriously affect the value of stock fixed in the organization of the Edison General company at $12,000,000. He holds that there are questions of fact and doubtful questions of law which can only be properly disposed of by a trial. As to the defendant corporations, the granting of a temporary injunction would result in great damage and loss, besides affecting seriously all of the $12,000,000 of stock, the holders of which acquiesced in and assented to the arrangement between the companies.

W. H. T.

San Francisco, Cal.

SAN FRANCISCO, Cal., May 16.—The Pacific Posta-Telegraph Cable company on Friday, May 1st, gave a general invitation to the public to inspect its new building in this city. About 500 guests responded. After giving a brief description of the various appliances and instruments L. W. Storrer, the local superintendent, announced that as he had been asked several times during the evening the length of time required to transmit and receive messages from various places, he would transmit the following message to Portland, New York, Washington, Seattle, Tacoma, Canso, Nova Scotia, and London, England: "Chief operator:—San Francisco is to-night inspecting the new office of the Postal Telegraph and Commercial Cable company. It is now 9:30 P. M. with us. What is the hour with you and the weather? SAN FRANCISCO."

The first reply came from Portland in three minutes, "Weather fair;" New York, three minutes and ten seconds, "Cloudy and warm;" Washington, three minutes and eleven seconds, "Cloudy and warm;" Seattle, three minutes and twenty-one seconds, "Cloudy and calm;" Tacoma, three minutes and twenty-eight seconds, "Cloudy, cool and calm;" Canso, Nova Scotia, four minutes and twenty seconds, "Cold and cloudy;" while the reply from London, "Foggy and cold," was received in six minutes and twenty-two seconds.

At its last meeting the San Francisco Board of Supervisors refused to grant the Omnibus Cable Railway company permission to operate overhead electric railway cars on streets in the business portion of the city through which cable franchises had been granted.

A company has been organized at Portland, Ore., to build an electric railway connecting Portland and Oregon City. The surveyors are now at work making the preliminary survey and the greater part of the right-of-way has already been secured. The road which will, perhaps, be the longest in the Pacific Northwest, will be about fifteen miles long, and the generating station will be located at the falls of the Willamette river at Oregon City, where unlimited water power may be had. The contract will call for the completion of the road to Oswego, where the iron mines and works of the Oregon Iron & Steel company are located, by the end of the year, and for the completion of the road by June 1, 1892.

The first attempt of the Electrical Improvement company to secure an electric lighting and power franchise from the new Board of Supervisors was defeated last Monday evening. Some members of the board stated that their objection to the proposed franchise was based upon the belief that the same had not been introduced in proper form, while others felt that they could not support it because of the conviction that all wires must go underground before long, hence it would not be wise to grant further permission for overhead construction. Several members of the Electrical Improvement company have organized a new company known as the Arc & Incandescent Electric Light company, and it is believed by many that the new organization will endeavor to obtain the franchise that the Improvement company has so long fought for in vain.

S.

Pittsburg, Pa.

PITTSBURG, May 16.—The first practical tests of writing telegraphy on long distances in this part of the country was made recently between this city and New York. The instrument in this city was placed in the office of J. H. Stevenson, above the Postal Telegraph office. In New York city the work was done from room 16 at 5 Dey street. At this end H. Ethridge was the operator, and at the other end the work was done by Max Gump, son of General Manager W. E. Gump, of the Writing Telegraph company. The wires used were the new copper wires of the Postal Telegraph line recently completed between this city and the East. This, of course, gave the machine an excellent chance to show what it could do, as the copper wire has a great many advantages over the ordinary iron wire in such a test. The first message received was a telegram to the Pittsburg *Dispatch* from its New York correspondent.

A Pittsburg inventor, D. J. Cable by name, claims to have made a novel invention, which consists of an aluminum boat to be propelled by electricity supplied from an aluminum battery. The battery, Mr. Cable says, will weigh but a couple of pounds, and will be sufficient to produce power for running a good sized pleasure boat. The difficulty in finding a soldering substance for the metal, Mr. Cable says, he has overcome. A boat capable of carrying four to six persons should not weigh more than sixty or seventy pounds, and would therefore be a very handy sort of a craft.

Mr. Westinghouse has at last announced to the stockholders of the Westinghouse Electric & Manufacturing company his plans for the reorganization of that company on a solid financial basis.

According to Mr. Westinghouse's plan a syndicate of eastern gentlemen has gone in with him to undertake the reorganization. This syndicate is composed of August Belmont, Jr., Marcellus Hartley, Henry B. Hyde, Brayton Ives, Charles Francis Adams and Charles Fairchild.

The capital stock of the company is not to be increased. The holders of the common stock outstanding are requested to surrender 40 per cent. of their holdings into the treasury, which, with the $3,000,000 preferred stock issued but not yet sold, will make about $6,000,000 of stock in the treasury. Of this $4,000,000 is to be converted into 7 per cent. stock, of which the $3 000,000 specified above is to be issued to care for the floating debt of the company and provide working capital, and $500,000 is to be held in the treasury to provide further working capital when needed. A part of the treasury stock is to be used to purchase further stock in the United States Electric Lighting company of Newark, N. J., and the Consolidated Electric Light company of New York City, in both of which companies the Westinghouse Electric & Manufacturing company is already interested.

Since the announcement of this plan was made to the stockholders last Monday a great deal of speculation has been going on as to whether the matter would be satisfactorily received by the stockholders, and it must be very gratifying to the company, as well as to the electric interests in general, that the majority of the shareholders have expressed their assent to the scheme and there is no doubt that at the next meeting the affairs of the company will take a very favorable turn.

The Duquesne Traction company made the first trial trip on its road last Monday and as everything went off very satisfactorily, there is every prospect that the road will be in complete operation by next week.

An ordinance has been offered in Allegheny City for the abolition of the big electric light towers which are now being used by the city. Ever since the city has been operating the electric light plant the people have complained that these towers are not satisfactory and there is a demand for mast arms like those used in the city of Pittsburg.

PITTSBURG, May 18.—The adjourned meeting of the stockholders of the Westinghouse Electric company, which was to have been held at 10 o'clock this morning, was, at the request of the board of directors, readjourned until June 1st. Mr. Westinghouse said that it was the desire of the board to give stockholders more time to assent to the proposed plan of reorganization. The reorganization can be effected as soon as nine-tenths of the stock is in the hands of the trust company; 50,000 shares have already been turned in, but a unanimous surrender of certificates is desired. Mr. Westinghouse says that there is no other way out of the difficulty, and that he expects that June 1st will see matters settled permanently. E. H. H.

Minneapolis, Minn.

MINNEAPOLIS, May 16.—Work on the extension of the lines of the electric street railway was commenced nearly a month ago and is being pushed rapidly. So far about six miles of track have been completed on the east side upon which the cars will be placed within a week. Two new car houses are being built, one on the east side 200x300 feet with a storage capacity of 200 cars and one on the inter-urban line about equi-distant between the two towns 100x300 feet in size, with a capacity of 115 cars. The power house at Minneapolis was found to be inadequate, and a large addition has just been built. Two Corliss engines, each of 1200 horse power capacity built by E. P. Allis & Co., Milwaukee, have been placed in this power house, but thus far one only has been put in service. Before the close of this month it is expected that 20 of the new motor cars for the inter-urban line will be ready, and this number will be increased as rapidly as possible to 40 or 45. These cars will be equipped with two 25 horse power Thomson-Houston motors and will pull from two to three trailers, and will, it is expected, reduce the running time to about 35 minutes. At the present time this company has in active service in Minneapolis 80 motors and 60 trailers with 20 motor cars on the inter-urban line. The entire system when completed, including St. Paul, will require about 230 miles of track and 500 cars And in addition about 20 miles of track connecting suburban towns is under consideration, and will probably be built in the near future.

The traffic on the line between the two cities has exceeded all expectations and will require a much heavier service than was at first contemplated. Messrs. W. F. Carr and C. C. Smith, electrical and mechanical engineers, with a large staff of assistants, have charge of the engineering departments covering all the new work under way, and such reconstruction as has been necessary.

The Northern Car company is having a very active season so far, and is employing a large number of men at its works at Robbinsdale. It has now in hand and nearly ready for delivery six of the largest cars ever built for street railway use. These cars were ordered by the Riverside Park Railway company of Sioux City, Iowa, and are to be used in a summer suburban traffic. The cars are 34 feet in length over all, the car proper being 28 feet, with a vestibule, and are equipped with a No. 20 McGuire steel truck and two 20 horse power Westinghouse motors. The interiors are finished in oak, with the Hale & Kilburn seat, presenting a light and attractive appearance. The Northern company also has under way forty closed cars 18 feet 6 inches in length, of a new design, to be used in Minneapolis and Duluth, and three summer cars, also of a new design, for the Elgin, Ill., company. The capacity of the plant is to be nearly doubled at once, which will insure

the early completion of the work in hand and a prompt beginning on a large number of new orders that have recently been secured.

W. E. Crane, who has been engaged in a long series of experiments looking to the perfection of an electric type-setting device, will open an office and laboratory in New York city within the next ten days, leaving Minneapolis temporarily at least. Mr. Crane has his inventions practically perfected and will give them to the public at an early day. H.

PERSONAL.

Alex. Kempt returned to Chicago last week from a trip through South Dakota.

S. D. Nesmith has been appointed manager of the Central Thomson-Houston company, Cleveland, O.

Charles Higgins was recently named for superintendent of the fire and police telegraph of St. Louis. The committee on fire department reported favorably, and the appointment was unanimously confirmed by the council.

NEW INCORPORATIONS.

Potomac Electric company, Washington, D. C.; capital stock, $25,000; to produce electricity for illuminating or power purposes.

Princeton Electric Light & Power company, Princeton Ill.; capital stock, $15,000; electric lighting and railway, use in Princeton.

Monticello Electric Light company, Monticello, Piatt county, Ill.; capital stock, $10,000; furnishing electric light, power and supplies.

Maxstadt Electric company, Chicago, Ill.; capital stock, $100,000; to manufacture and sell electric trusses, compounds and electric devices.

Connellsville, New Haven & Leisenring Street Railway company; capital stock, $100,000; street railway by electric, horse or cable power.

Great Western Electric Supply company, Charles City, Ia.; capital stock, $5,000,000; buy, sell, manufacture and deal in all kind of electric supplies.

Salina Electric Railway company, Salina, Kan.; capital stock, $100,000; to maintain and operate by electricity a line of railroad in the city of Salina.

People's Electric Light, Heat and Power company, of Greenville, Pa.; capital stock, $25,000; supplying light, heat and power by means of electricity.

Gettysburg Electric Light, Heat & Power company, Gettysburg, Adams county, Pa.; capital stock, $23,000; supplying light, heat and power by electricity.

Waynesboro Electric Light & Power company, Waynesboro, Franklin county, Pa.; capital stock, $15,000; supplying light, heat and power by means of electricity.

Trenton Railroad company, Trenton, Mo.; capital stock, $6,000; to construct and operate horse railroads, to purchase, construct and operate electric and cable railroads in any part of Missouri.

Jackson Cady Electric Railway Signal company, Portland, Me.; capital stock, $1,000,000; to acquire and dispose of letters patent relating to electric signals for use in connection with the operation of railways.

Carpenter Electric Heating Manufacturing company, St. Paul, Minn.; capital stock, $400,000; to manufacture and sell electric heating appliances and apparatus of every description, electric motors, electric dynamos, etc.

Massachusetts Manufacturing & Electrical Supply company, Chelsea, Mass.; capital stock, $25,000; to manufacture buy and sell all kinds of woodwork, electrical machinery and supplies, and to apply and fit the same to buildings.

W. D. Graves Electrical & Manufacturing company Cleveland, O.; capital stock, $25,000; manufacturing and dealing in electrical goods, apparatus and appliances, all kinds of machinery, and to own and control United States patents, etc.

Lincoln Electric Railway company, Lincoln, Neb.; capital stock, $100,000; to construct, own and operate a system of suburban and street railroad, and to generate and rent power and light, and to own all necessary real estate with suitable tracks, etc., and appliances for same.

ELECTRIC LIGHTING.

An electric light plant is to be erected at Dayton, Tenn.

It is reported that Rockdale, Tex., is to have an electric light plant.

Union City, Tenn., has decided by a popular vote to have electric lights.

Contracts have been let for the erection of an e'ectric light plant at Arkansas Harbor, Tex.

The Paris municipality has renewed for ten years the contracts for the electric lighting of the boulevards.

The Board of Trustees of Versailles, Ky., has advertised for sealed bids for lighting the town by electricity.

The city of Jackson, Tenn., has decided to issue bonds to the extent of $75,000 to provide money for an electric light plant.

At Hagerstown, Md., a new company has been organized with a capital stock of $35,000 to furnish gas and electric light.

It is a noticeable fact that municipalities find it harder to procure authority to do commercial lighting than to light he streets. The latest instance is at Crawfordsville, Ind., where the city council amended that part of the resolution referring to commercial lighting and confined itself to a plant to do public lighting.

The New Albany, Ind., Electric Light, Heat & Power company—capital, $700,000—assigned to Charles W. Sowle on May 18th. The estimated liabilities are $50,000; assets, about the same.

The Electric Light commission of Wheeling, W. Va., has reported that an electric light plant suitable to the requirements of the city would cost about $100,000. The city council set aside the sum named to provide for the erection of a plant.

The Electrical Engineering company of St. Paul has recently sold to the city of Audubon, Ia., a 750 light alternating plant made by the National Electric Manufacturing company of Eau Claire. The work of installation will commence in a few days.

All cities of the third class in Missouri have been empowered by the legislature to erect, maintain and operate gas and electric works. A contemporary remarks: "If this theory is a good one for the third class cities, why isn't it good for the first and second? And if it is bad policy for the first and second, why isn't it as bad for the third?"

At the annual meeting of the River & Rail Electric Light company at Charleston, W. Va., the following named directors were elected: Geo. L. Wright, F. W. Holls, Henry E. Tremain, Albon Man, R. F. Rogers, F. F. Randolph, and W. C. Brown, New York City; Wm. Main, S. B. Chittenden, S. R. Bradley, Brooklyn; Benj. Butterworth, Chicago.

The Thomson-Houston Electric company reports the following recent installations made by its western isolated lighting department: Thos. Kane & Co., 137 Wabash avenue, Chicago, 50 light incandescent plant to run in connection with Regan Vapor engine; Wm. Ruehl Brewing company, 224 West Twelfth street, Chicago, 200 light incandescent plant; Hagar & Johnson Manufacturing company, Marquette, Mich., 250 light incandescent plant; Rankin & Pritsch Foundry and Machine company, St. Louis, Mo., 18 light arc plant; Morrisson, Plummer & Co., 200 Randolph street, Chicago, 250 light incandescent plant.

ELECTRIC RAILWAYS.

The electric railway connecting Lebanon and Annville, Pa., is to be completed by July 4th.

George J. Morse has secured a franchise to construct an electrical railroad at Dayton, Tenn.

The electric power house of the Capital Street Railway company of Little Rock, Ark., will cost $46,000 and have ground dimensions of 90 by 300 feet.

The Pimlico & Pikesville Railroad company of Pikesville, Md., has been granted authority by the county commissioners to construct an electrical railroad.

The Birmingham, Ala., Railway & Electric company has, it is stated, closed a contract with the Thomson-Houston Electric company for the equipment of its railway with the electric system.

In commenting on O. T. Crosby's experiments in the line of electric railway propulsion at high speeds, the London *Electrical Engineer* says: "In a country where time is so valuable as in the United States, and where it now takes seven days to cross from New York to San Francisco, a scheme of rapid traveling such as this, if taken up by practical men, may with some probability be expected before very long to lead to results which will astonish the skeptics. At any rate, we certainly see a possibility of higher railway speeds, and we can, at least, hope for the practice."

ELECTRIC MOTOR.

A project for the construction of a number of electrically propelled boats to ply on the Seine is under advisement in Paris.

The Russian government has just placed an order with an English electrical company for the equipment for an electric launch 40 feet long.

Water power, transmitted by electricity, is utilized to operate mills at Quartertown, near Mallow, in Ireland. This is said to be the first installation of this character in the Emerald Isle.

ELECTRIC MINING.

The Jeffrey Manufacturing company has installed electric coal mining plants as follows: Helvetia Mines, Helvetia, Pa., four electric machines; Red Stone Coal & Coke company, Grindstone, Pa., two electric machines; Union Colliery company, Victoria, B. C., four electric machines.

Skilton & Son, 31 and 33 Broadway, New York, have been appointed agents for the Bain Electric Manufacturing company for Mexico, Central and South America and the West Indies, for the sale of electrical apparatus for the transmission of power and for mining purposes. Mr. Bain reports a largely increasing demand for apparatus for electric coal mine haulage. This company recently shipped a 50 horse power dynamo to the Electric Coal Mining and Machinery company of Pittsburg. The company is winding an extra armature for a 125 horse power dynamo for the Crescent Coal company of What Cheer, Ia. The latter company operates its electric plant during the day for under cutting and drilling and at night for clearing the mine of water.

TELEGRAPH.

In future no censorship of telegrams will be exercised in Germany except in times of public danger.

The Danville, Va., & East Tennessee Telegraph company has been incorporated with a capital stock of $90,000.

A second cable is to be laid between the Island of Corsica, in the Mediterranean, and the mainland. It will give Corsica direct telegraphic communication with Marseilles.

The new submarine cable works at Calais, France, were opened on April 18th. A cable 1,062 miles in length, and weighing 2,367 tons, was the first turned out of the new shops.

The statistics of the Austrian post telegraph department for 1889 have just been published. The receipts were, including international telegrams, 4,181,087 florins, against 3,899,628 in 1888, an increase of 7 per cent. The total number of messages was 25,192,235, as against 23,839,620 in 1888, an increase of nearly 6 per cent. The government now owns 26,677 kilometers of trunk lines, comprising 73,003 kilometers of wires. During 1889 42 central telephone stations were opened, including those belonging to private companies, and 96,322 telegrams were transmitted by telephone to telegraph offices, and 128,094 telegrams were transmitted by telephone to subscribers.

A distilling company sent a telegram to boilermakers in a neighboring city notifying them that a boiler was out of repair and asking them to "send man at once." By reason of the failure of the telegraph company to transmit or deliver the message, the distilling company was compelled to suspend operations for twenty-four hours longer than it would have done had the message been transmitted and delivered in the regular course of business. The Superior Court of Kentucky held, in an action against the telegraph company, that the sender of the message was entitled to recover for the additional expense incurred in feeding cattle, and the additional amount paid to hands, by reason of the delay caused by defendant's failure to transmit the message.

TELEPHONE.

At Bridgeport, Conn., the telephone wires of the Southern New England Telephone company are being put under ground.

The newly organized Natchitoches Telephone company will construct and operate a telephone line from Natchitoches to Cypress, La.

An epidemic of influenza recently attacked the operators in the switch-room of the National Telephone company's station at Manchester, England. The service was greatly interfered with for some time, although the difficulty was partially met by procuring operators from other cities.

A serious drawback to the use of the Anglo-French telephone line is the difference in the languages used at the termini. Many queer mistakes have already been reported. An amusing blunder was made in the case of an English correspondent who wished to telephone to Paris to say that there was a grand success at the Prince of Wales Theater of "L'Enfant Prodigue." This he had pronounced "L'Onfong Proddigg, Prangce of Wales," which the French reporter at the other end, not being accustomed to the English accent, took for English "Hong Kong, strong gale"—that is, for a notification of a storm at Hong Kong.

It is reported that the National Telephone company has resolved to construct a telephone line between Scotland and England. In making this statement an Edinburg paper has this to say: "The two countries are indebted to this telephone company for a large share of the blessings it has, and had it not been for the crass stupidity of post-office officialism, these benefits would have been far greater. There is, however, something very far wrong when our postoffice is concerning itself with such idle schemes as telephone lines between London and Marseilles, and London and Bordeaux, while all the time scarcely two important towns of Great Britain and Ireland are in telephonic communication with each other."

Detroit has been greatly afflicted with labor troubles; but few of the residents of that city realized how great was the danger that threatened them when the telephone company enforced its new rules May 1st. According to a press dispatch the operators were greatly disturbed over the new rules which prohibit chewing gum during working hours interdict any private conversation over the wires, and require them to give their number instead of saying "Hello." The girls "talked strike" in subdued tones. The day girls would be willing to strike but they are not organized, nor have they time to organize, and in addition to this fear their chances of success would be very small. The night girls have no more privileges, but have more time to themselves. Neither set will trust the other to organize a union. The girls are still angry, however, and have been muttering about the new rules ever since they went into effect.

MISCELLANEOUS.

A dividend of 75 cents per share has been declared on the Fort Wayne Electric company's stock.

During the progress of the Frankfort electrical exhibition A. Egts of Oldenburg will deliver popular lectures on electrical phenomena and appliances. The formal opening of the exhibition took place on May 16th.

An English electrical paper states that the municipality of Geneva, Switzerland, has made a grant of 60,000 francs toward the erection of luminous fountains, which, it says, promise to surpass those seen at the South Kensington and Paris Exhibitions. The fountains will be erected in the harbor near the left shore. A dynamo with a turbine

of 75 horse power will be installed, and the water will be taken from the reservoir at Bessinges ob Cologny. Six arc lamps with silver plated reflectors will be used for the illumination of the main jet, which is to be 90 meters in height, and of the additional jets. The fountains will throw up 500 liters per second, or double the quantity of water thrown up by the fountains in the Champ de Mars, at the Paris Exhibition of 1889. The color effects will be obtained by the system first used at the South Kensington Exhibition.

At Halifax, Nova Scotia, a signal gun is fired from the citadel each day at noon and at 9:30 P. M. A cable has been laid from a clock maker's establishment to the citadel, and is connected with a clock which automatically fires the gun. The dial of this clock has two small receptacles containing mercury. One of these is so placed that the reverse end of the record hand will touch the mercury when the index end points to the sixtieth second. When the minute hand touches the mercury in one receptacle and the second hand touches it in the other the circuit is completed, and the big gun at the citadel is discharged by an electric circuit passing from the clock.

William Maver, Jr.'s., work on "American Telegraphy," upon which he has spent several years, will soon be issued. The book will comprise about 600 pages, including over 400 diagrams and engravings. Following is a list of the principal subjects discussed: Morse telegraphy, including switch-boards, lightning arresters, etc.; quadruplex telegraph systems; duplex telegraph systems; telegraph and general electrical testing; galvanometers; printing telegraph systems; stock ticker telegraphs; Wheatstone, chemical and other automatic telegraphs; fire alarm telegraphy; automatic telegraph repeaters including the Wheatstone repeater; automatic fire alarm telegraphy; American district telegraphy; police patrol telegraph systems; electric railway block-signaling; bank and burglar alarm telegraphy; time telegraph circuits; writing telegraph systems; military telegraphing; submarine telegraphy; telegraphing to and from moving trains; telegraph and telephone working on the same wire; dynamo machines in telegraphy; primary batteries; telegraph construction, etc., etc. The book is being published by J. H. Bunnell & Co., 76 Cortlandt street, New York.

TRADE NEWS.

A large addition to the Ball Engine Works at Erie, Pa., is in course of erection.

The Short Electric Railway company of Cleveland, O., has issued a neat booklet setting forth the merits of the Short gearless motor.

The Globe Carbon company has broken ground for a new factory at Ravenna, O., which will be double the size of the present factory. It is expected that the new works will be completed in Seplember.

Announcement is made that the Ball & Wood company, 15 Cortlandt street, New York, has succeeded the firm of Charles R. Vincent & Co. as selling agent for the Ball automatic cut-off engine. The members of the latter firm have connected themselves with the new company.

BUSINESS.

The S. S. White Dental Manufacturing company of Philadelphia has purchased the patents of the Partz batteries and is furnishing them for running light machinery.

The special advantages to be derived from using the new Standard Twin conductor of the Interior Conduit & Insulating company, New York, have been thoroughly presented in a circular issued by the company. The large sales reported during the week would seem to indicate that construction companies already recognize the value of this invention.

Chas. A. Schieren & Co. of New York recently gave the Electric Light company of Owensboro, Ky., the privilege of perforating a belt which had given considerable trouble. After the change had been made the electric light company wrote Schieren & Co.: "We have perforated the belt and are more than pleased with it; we used to have to run it so tight it was very near impossible to keep the journals cool; it now runs very slack and without waving or flopping."

Letters from the Weir Frog company of Cincinnati, O., and the John Brenner Brewing company of Covington, Ky., testify to the appreciation in which the Triumph compound engine is held for furnishing power for electric light plants. Mr. Weir states his belief that "it is the engine best adapted to the electric light plant that has yet been produced," while the president of the brewing company says "that the engine is operating our arc and incandescent dynamos to our entire satisfaction."

The Sioux City Engine Works report business as improving greatly in the past two weeks. They have steadily had work since January 1st for their standard Corliss and Giddings Automatic engine, and have a large number of engines finished and ready for prompt delivery. The prospects for the season's business were never before better at this time of the year. The applications for estimates and prices are largely for the larger size engines and steam plants. They are now completing some special machinery which will greatly increase their facility for both quantity and quality of work, and are also intending to put in a large night force soon to run for the next six months in order to keep up with the demands of their trade. Among the recent orders for electric light plants are two compound condensing engines sold to W. J. Hobson for his electric lighting and railway plant now building at Waco, Tex.; one to the Sioux Refrigerator company, Sioux City, for electric lighting, and to operate the elevators; one to James F. Toy of Sioux City for electric lighting, and one 250 horse power Corliss to the Lincoln City Electric Railway company, Lincoln, Neb., the second within a year.

An office of the Electrical Engineering & Supply company, St. Paul, has been opened at room 931, the Rookery, Chicago, as a local agency for the National dynamos and apparatus, and as a purchasing agency for the main office at St. Paul and the Duluth branch, with W. D. De Munn in charge. C. A. Daigh, who was formerly manager of the N.W. Thomson-Houston company, St. Paul, is president of the company, and Morgan Brooks, formerly treasurer of the St. Paul Gas company, treasurer. A. B. Sibley, who has also held a prominent position with the gas company, has just been elected secretary. F. J. Cram, formerly with the N. W. Thomson-Houston, is general agent of the company, and will represent it on the road, traveling from both Chicago and St. Paul. Mr. Daigh will spend a large part of his time in the Chicago office. This will make a strong combination in the electrical field.

ELECTRICAL PATENTS.

Issued May 12, 1891.

451,909. Brush Holder. Harry H. Blades, Detroit, Mich.

451,921. Secondary Battery. Julius Emmner, Jr., Washington, D. C.
The first claim is:
"In a secondary battery the combination of a vessel, an electrolytic fluid and two elements, each consisting of a receptacle of aluminum containing active material, such as chloride of aluminum."

451,922. Automatic Toll Box. Isaiah H. Farnham, Wellesley, Mass.

451,933. Coupling for Electric Wires. Andrew M. Hunt, Newark, N. J.

451,941. Conduit for Electric Wires Thomas T. La Point, James H. Flanagan and Charles A. Thompson, New Haven, Conn.

451,942. Motor Truck. Francis M. Lechner, Columbus, Ohio.

451,948. Galvanic Battery. George C. McCullough, Richmond, Ind.
The galvanic battery cell is provided with positive and negative elements and supplemental positive and negative elements, whereby one pair of elements may be used while the other pair is permitted to rest.

451,950. Electric Insulator. Samuel Oakman, Melrose, Mass.

451,951. Printing Telegraph. Edwin Pope, Quebec, Canada.

451,960. Machine for Covering Electrical Conductors with Lead. Lewis W. Tracy, New York, N. Y.

451,980. Electrically Propelled Car. Sidney H. Short, Cleveland, Ohio.
The last claim reads:
"19. The combination, with a car of an electric propelling motor comprising an armature axially mounted upon and directly secured to a car axle, and non-rotative multipolar field magnets mounted to have movement independently of said armature at the sides of the same."

451,981. Mounting for Electric Car Motors. Sidney H. Short, Cleveland, Ohio.

451,996. Drop for Electric Lamps. Willard E. Dow, Braintree, Mass.

451,997. Fusible Cut-out for Electric Connections. Willard E. Dow, Braintree, Mass.

451,999. Electric Railway Signal. Willie Cowles Walter, Richmond, Va.
Claim two reads as follows:
"In an electric railway signal the combination with a line circuit of a switch rail and a stationary mounted coiled contact spring separate from and arranged in the path of said switch rail parallel with the plane in which said rail moves to electrically engage said switch rail."

452,003. Electro Magnet. Charles E. Lipe, Syracuse, N. Y.
The third claim is given:
"The method of producing an electro magnetic coil whose convolutions shall be substantially rectangular in cross section, which consists in making the wire from which the coil is wound of irregular quadrilateral cross section, as described, and coiling said wire upon the shorter side of said quadrilateral."

452,005. Driving Mechanism for Electric Motor Cars. Sidney H. Short, Cleveland, Ohio.

452,017. Electric Wire Suspender. Charles A. Lieb, New York, N. Y.

452,026. Electrical Signaling Device. Charles J. Kintner, New York, N. Y.
The last claim is:
"12. In a signal transmitter, a signal transmitting disk having a pre-arranged signal on its face, and a notched protecting disk or guard, in combination with a pivoted transmitting lever having its contacting end located in the path of the notch."

452,035. Motor Car for Electric Railways. Sidney H. Short, Cleveland, Ohio.
This invention has special reference to motor cars in which a propelling motor mounted on a driving axle has its axially placed armature connected directly with the driving axle, so as to revolve therewith at equal speed. By "axially placed" is to be understood that the axes of the armature and driving axle are coincident, or nearly so.

452,036. Machinery for Propelling Electric Cars. Sidney H. Short, Cleveland, Ohio.
The last claim is:
"9. The combination of an electric car motor journaled at one end to a car axle, but insulated therefrom, and supported at the other end by a cross bar insulated from the side bars of the truck frame, with insulating gearing connecting the armature of the motor with the car axle, and an insulating gear box surrounding the gearing."

452,041. Method of Braking Trains. Elias E. Ries, Baltimore, Md.
Claim eight reads:
"The herein described method of braking a traveling vehicle or train, which consists in applying mechanical pressure to prevent the rotation of the wheels and in braking the vehicle or train by electrically increasing the friction between the said wheels and the rails."

452,042. Electric Riveting Apparatus. E. E. Ries, Baltimore, Md.
The last claim is as follows:
"17. In an electric riveting apparatus a heading die and anvil composed of aluminum bronze having higher specific conductivity than the metal of the rivet operated upon."

452,056. Apparatus for Heating by Electricity. Chas. Zipernowsky, Buda-Pesth, Austria-Hungary.

452,068. Coin Operated Machine. William H. Ashwell, St. Louis, Mo.

452,072. Automatic Railway Signaling Apparatus. Stanislaus J. Doucet, Shippegan, Canada.

452,091. Process of Treating Conductors. James B. Williams, Oakland, Cal.

452,099. Electric Railway. Mark W. Dewey, Syracuse, N. Y.
Of the seventeen claims the sixteenth is given:
"In an electric railway having a conduction system for one portion and an induction system for another portion, means for supplying the conduction system with a direct current and the induction system with an alternating current."

452,151. Self-Controlled Motor Switch. George H. Whittingham, Baltimore, Md.

452,152. Thermal Cut-out. George H. Whittingham, Baltimore, Md.

452,160. Electric Railway. Francis O. Blackwell, New York, N. Y.
The second and last claims follow:
"2. In an electric railway conduit, the combination with an inclosed conductor, of a swinging support therefor."
"63. In an electric railway, the combination, with an inclosing conduit, of a supply conductor, an insulator for said conductor of porcelain or similar material, a metallic embracing piece for the insulator attached to the conduit, and an intermediate filling of lead or equivalent metallic deadening material."

452,165. Visual Indicator for Fire-Alarm and Other Purposes. Moses G. Crane and Frederick W. Cole, Newton, Mass.

452,166. Bell Striker. Moses G. Crane, Newton, Mass.

452,173. Combined Coupling and Cut-out. Joseph D. F. Andrews, Westminster, England.
The invention consists of a block of incombustible material having recesses filled with cast metal plugs and provided with a groove within which is arranged a fusible wire having its ends embedded in the cast metal plugs.

452,176. Electric Car Motor. John Christiansen, Quincy, Mass.

452,185. Wire Clamp. Robert M. Jones, Salt Lake City, Utah.

452,186. Trolley Stand. Robert M. Jones, Salt Lake City, Utah.

452,211. Crane for Electric Lamps. Emilio Cardarelli, Sumter, S. C.

452,214. Electric Motor. Daniel J. Chisholm, New York, N. Y.

452,220. Surgical Electrode. Josephus H. Gunning, New York, N. Y.

452,250. Electric Belt. Charles D. Williams, Silver Lake, Kan.

452,255. Tubular Pole for Electrical Railroads. Thomas J. Bray, Warren, O.

452,276. Electric Meter. Herbert W. Miller, London, Eng.

455,281. Railway Signaling Device. James C. O'Neil, Cleveland, O.

452 288. Holder for Portable Electric Lamps. William W. Savage, Toronto, Can.

452,296. Electric Reciprocating Engine. Charles J. Van Depoele, Lynn, Mass.

452,299. Clock Synchronizer. Arthur G. Wiseman, Webster Grove, Mo.

452,303. Primary Battery. Walter Hanson, London, Eng.

452,305. Incandescent Electric Lamp. William M. B. Keen and William F. Haarmann, New York, N.Y.

452,306. Incandescent Lamp Socket. William M. B. Keen, New York, N. Y.

452,326. Electrical Measuring Instrument. Edward Weston, Newark, N. J.

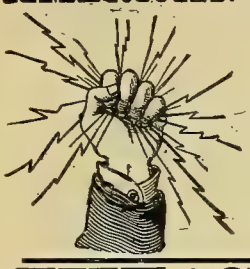
452,340. Electric Cable. William A. Conner, Pittsburg, Pa.
The cable has its wires covered with saturated fibrous material so applied as to form an open mesh, thus providing air spaces.

452,341. Electric Cable. William A. Conner, Pittsburg, Pa.

452,342. Electric Cable. William A. Conner, Pittsburg, Pa.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

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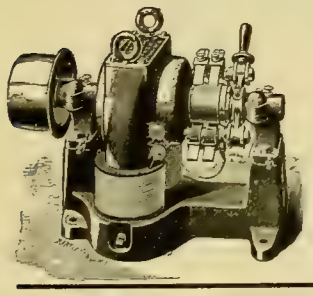

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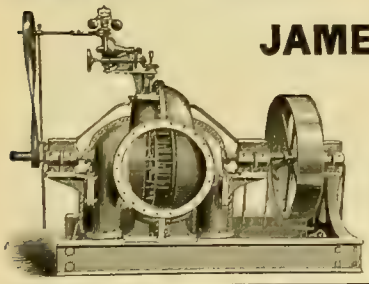

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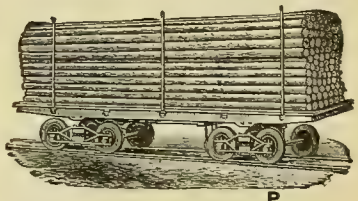

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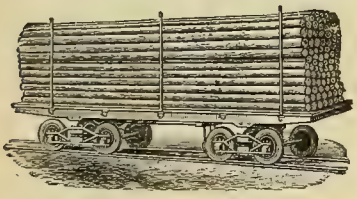

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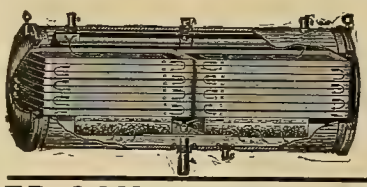

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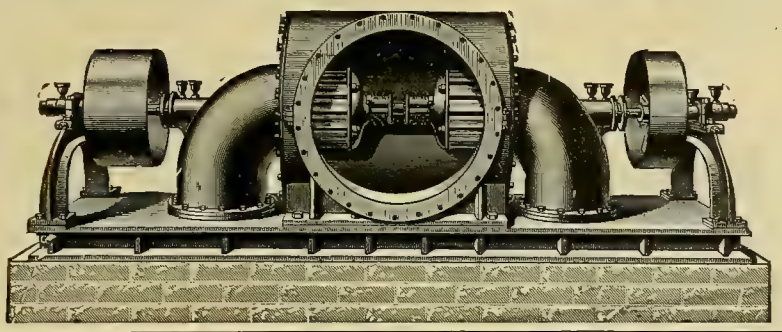

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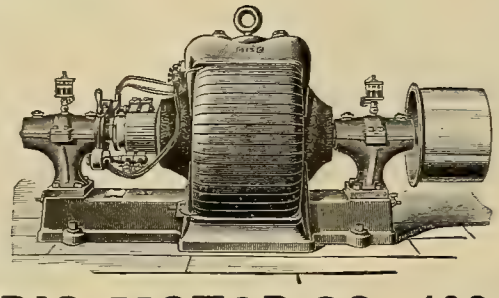

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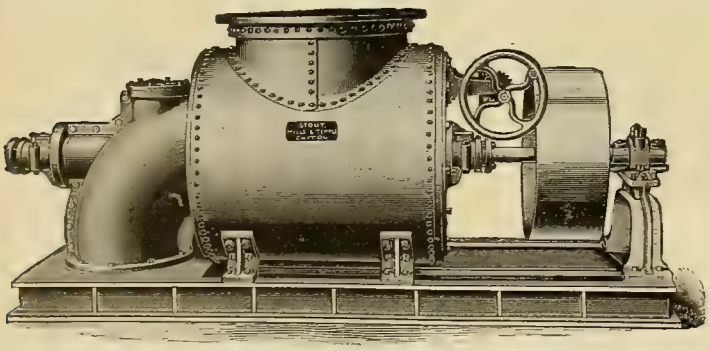

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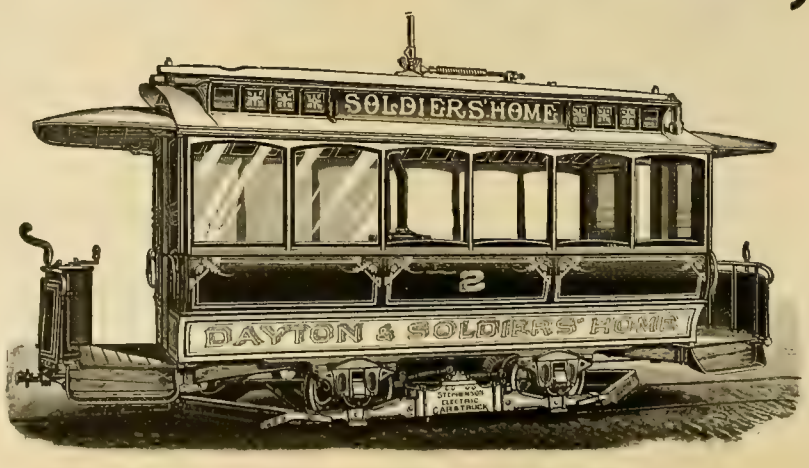

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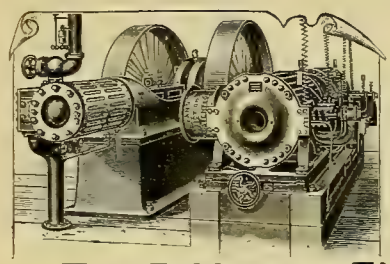
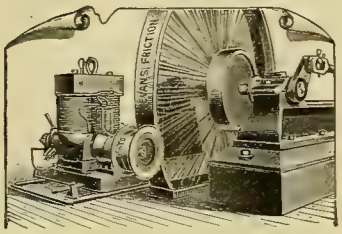
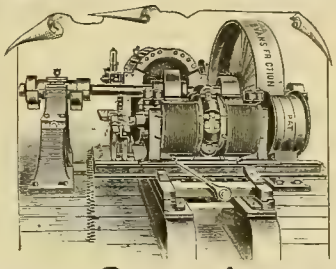
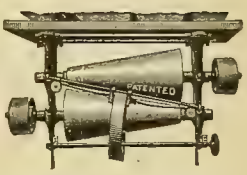

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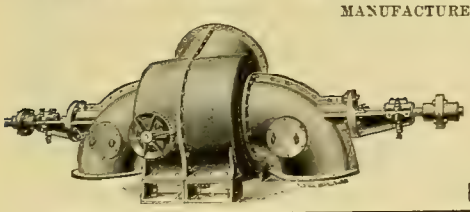

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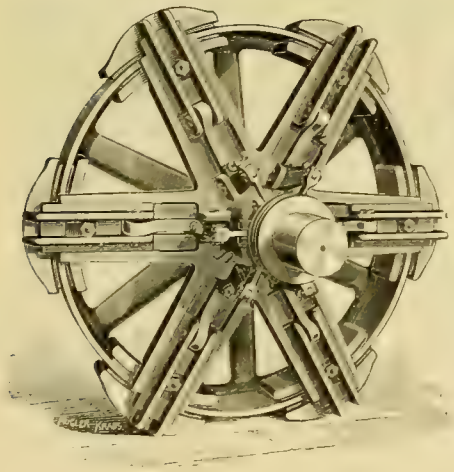

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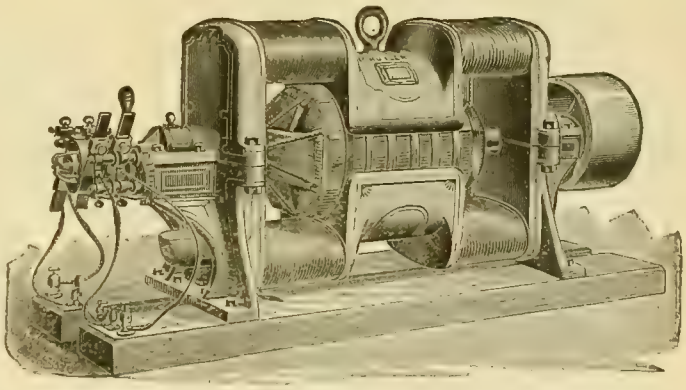

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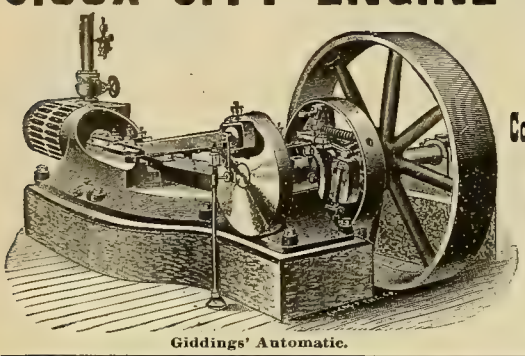

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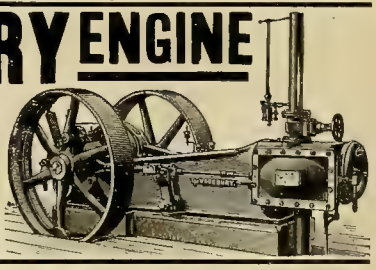

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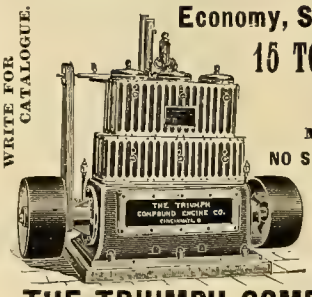

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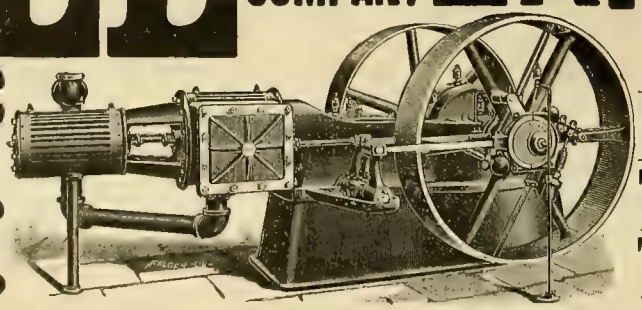

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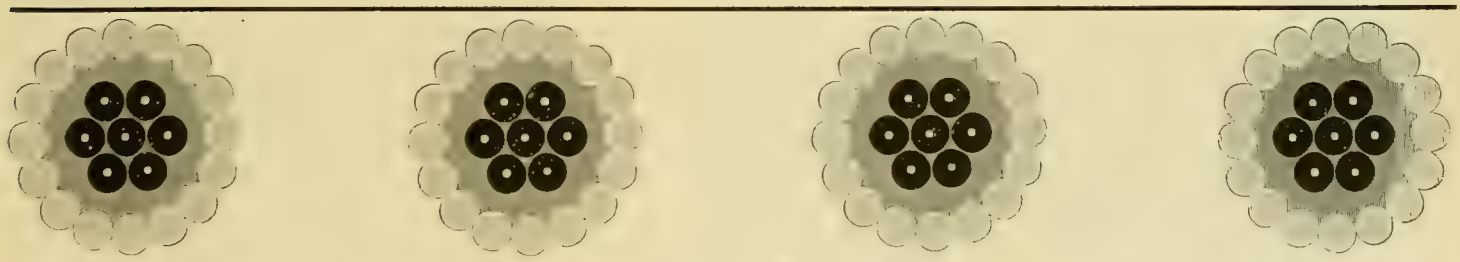

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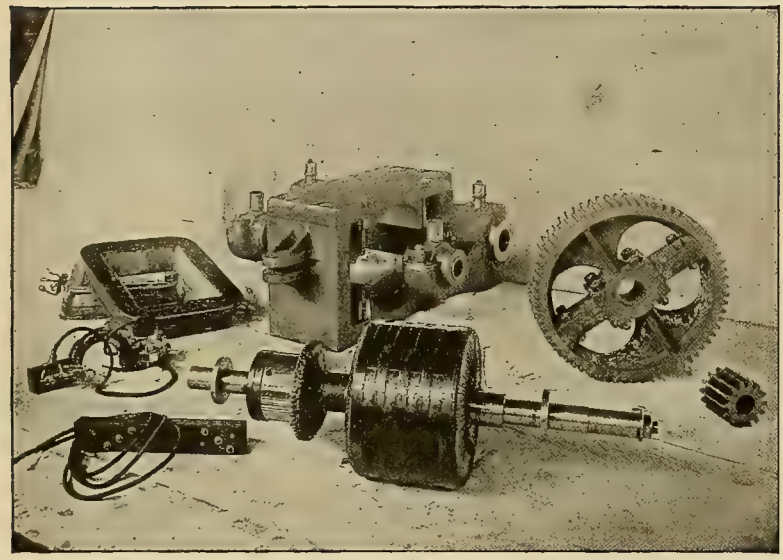

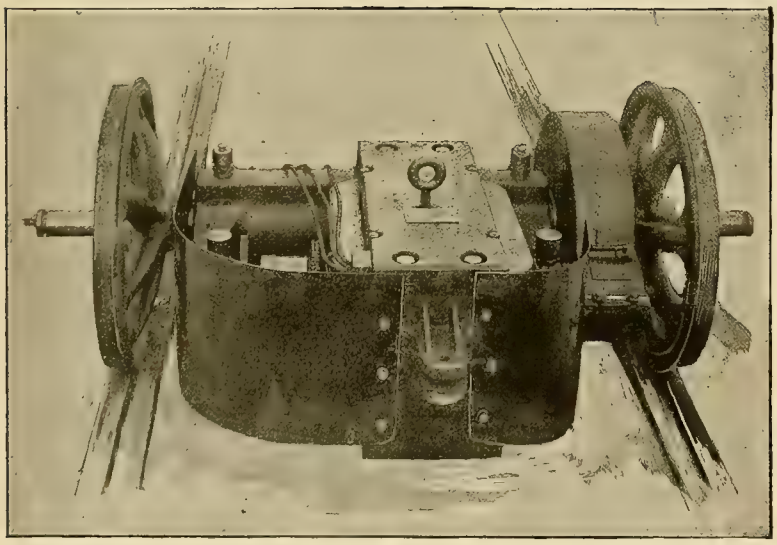

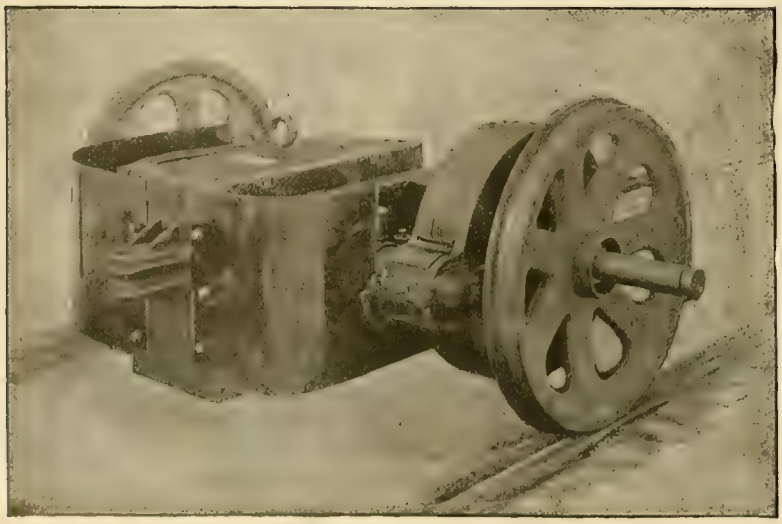

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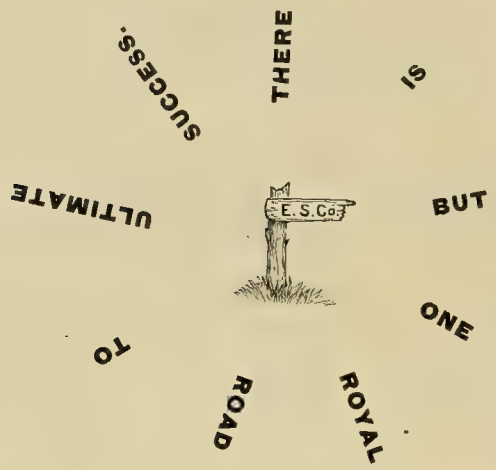

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Beware of the smooth-tongued, Janus-faced pilgrim, Mr. Lo Firstcost; his apparel is flashy; he points to a highway of seeming beauty, but it leads to a great Plain of Disappointment.

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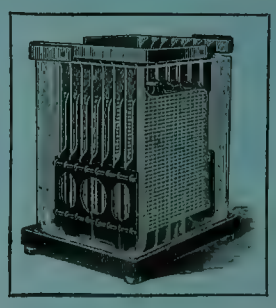

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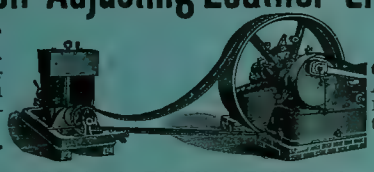

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THE TRADE WILL BE PROPERLY PROTECTED.

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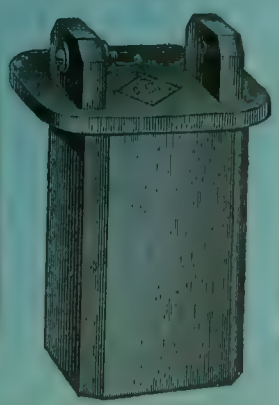
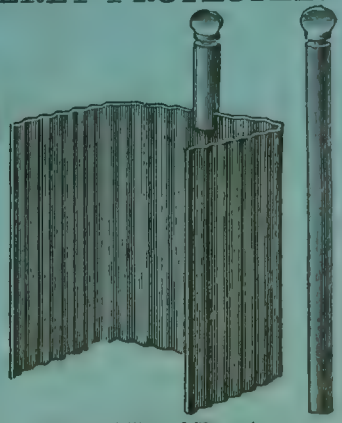


Carbon Reservoir and Cover of Champion Battery.



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12,800	TENNESSEE,	1,485
1,500	SOUTH CAROLINA,	NONE.
18,450	TOTAL,	3,685

FIVE TIMES as many of the Thomson-Houston System as of

ALL OTHERS COMBINED.

The figures referring to "total of all systems," taken from table published in August number of "Electrical Industries," for year 1890, are of undisputed accuracy.	Total of all systems.	Thomson-Houston System.	
		Number.	Percentage to total of all systems.
Vermont, - - - -	6,350	4,150	$65\frac{3}{10}$ per cent.
Tennessee, - - - -	14,285	12,800	$89\frac{1}{2}$ per cent.
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Brush Electric Co.

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Cowles Syndicate Co.
Cleveland Aluminum Co.
Freeman, Coleman & Co.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
GreatWestern Electric Supply Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Anti-Friction Metal.
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Brush Electric Co.
Easton Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
McLaughlin, Jas.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co.,The.
Fletcher & Fletcher Electric Co.
GreatWestern Electric Supply Co.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Southern Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Northwestern Elect. Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Wollensak, J. F.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.
Standard Electrical Works.
Stanley & Hall.
Star Electrix Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne &Co., Geo. W.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co.,The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
(See Wire Insulated.)

Cable, Electric, (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Minneapolis St. Ry. Co.
Stephenson Co., John.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Electric Construction & Supply Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Chicago Electric Mfg. Co.
Knapp Electrical Works.
McLaughlin, Jas.
Shawhan Machine Works.
Temple, J. C.
Western Electric Co.

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Chicago Electric Mfg. Co.
Edison General Electric Co.
Electrical Engineering Co.
Engineering Equipment Co.
Hutton, Henry.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Temple, J. C.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Roebling's Sons Co., Jno. A.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Holmes, C. H.
Monitor Electric Co.
Southern Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Automatic Switch Co.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Paiste, H. T.
Partrick & Carter Co.
Southern Electrical Supply Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
Colburn & Co., I. W.
Easton Electric Co.
Electrical Engineering Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Howard & Co., Hiram M.
Heisler Electric Light Co.
Little & Co., F. P.
National Electric Manufacturing Co.
Schuyler Electric Co.
Shawhan Machine Works.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Specialties.
Hipwell Mfg. Co., H. H.
Northwestern Elect. Specialty Co.
Turner Brass Works.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Engineering Equipment Co.
Pearson & Co., W. B.
Pond Engineering Co.
Sioux City Engine Works.
Stearns Mfg. Co.
Triumph Compound Engine Co.
Westinghouse Machine Co.

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Braun Illustrating Co.

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Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Cleverly Electrical Works.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.
Wollensak, J. F.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Cleverly Electrical Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Holmes, Booth & Haydens.
Holtzer-Cabot Electric Co.
International Okonite Co., The.
Knapp Electrical Works.
Lennon, J. M.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Stanley & Hall.
Standard Electrical Works.
Thomson-Houston ElectricCo.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.
Wollensak, J. F.

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Baggot, E.
Great Western Electric Supply Co.
Phœnix Glass Co.

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Butler Hard Rubber Co.

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Butler Hard Rubber Co.
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Electrical Supply Co., The.
Empire City Electric Co.
Fletcher & Fletcher Electric Co
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Monitor Electric Co.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Paint Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Interior Conduit & Insulation Co.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Electrical Works.
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Western Electric Co.

Journal Bearings.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Buckeye Electric Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
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Greeley & Co., The E. S.
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Knapp Electrical Works.
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Monitor Electric Co.
Sawyer-Man Electric Co.
Southern Electrical Supply Co.
Sunbeam Incandescent Lamp Co.

Lamps, Incandescent—Contd.
Thomson-Houston Electric Co.
Western Electric Co.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
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Partrick & Carter Co.

Mica.
Munsell & Co., Eugene.

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Edison General Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Electric Mfg. Co.
Brush Electric Co.
Baxter Electric Motor Co.
Calkins & Son J. W
Card Electric Motor & Dynamo Co.
Crocker-Wheeler Electric Motor Co.
C. & C. Electric Motor Co.
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Easton Electric Co.
Edison General Electric Co.
Electrical Engineering Co.
Elektron Manufacturing Co.
Hawkeye Electric Mfg. Co.
Lennon, J. M.
Shawhan Machine Works.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Westinghouse Electric & Mfg. Co.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Packing.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Holmes, C. H.
Standard Electrical Works.
Southern Electrical Supply Co.
Western Electric Co.

Poles.
Brownlee & Co.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Holmes, C. H.
Milliken Bros.
Sterling, W. C.
Star Iron Tower Co.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Knapp Electrical Works.
Northwestern Elect. Specialty Co.
Partrick & Carter Co.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
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Separators, Steam.
Pond Engineering Co.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Western Electric Co.
Wollensak, J. F.

Speed Indicators.
Queen & Co.

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Minneapolis Street Ry. Co.

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Electric Merchandise Co.
Electric Railway Specialty Co.

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American Electrical Works.
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Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Western Electric Co.

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Greeley & Co., The E S.
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Monitor Electric Co.
Partrick & Carter Co.
Standard Electrical Works.
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Standard Electrical Works.
Western Electric Co.

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Electrical Supply Co , The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co

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Wrizley, T.

Transformers.
Stanley Electric Mfg. Co.

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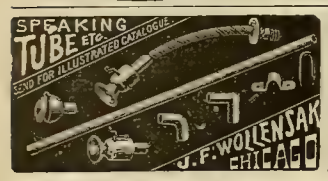

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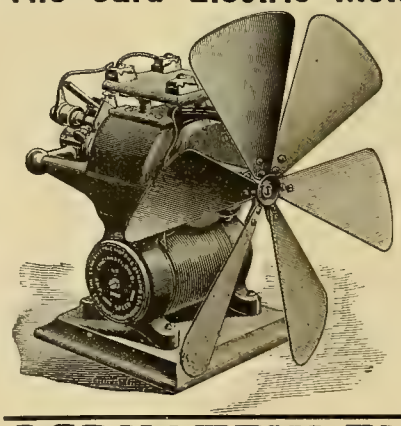

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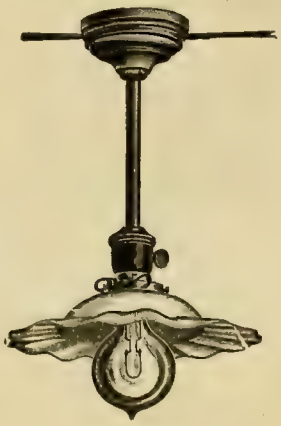

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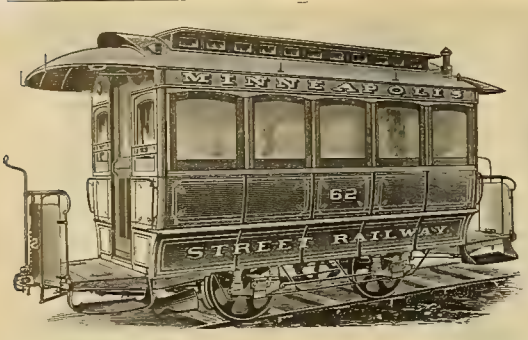

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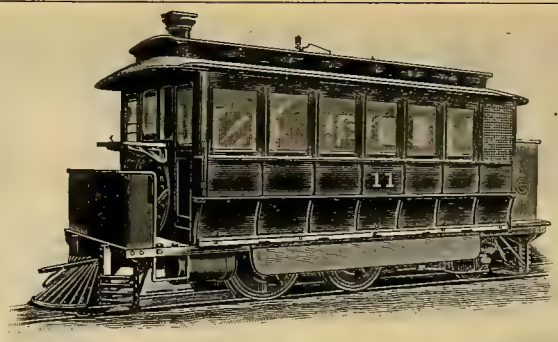

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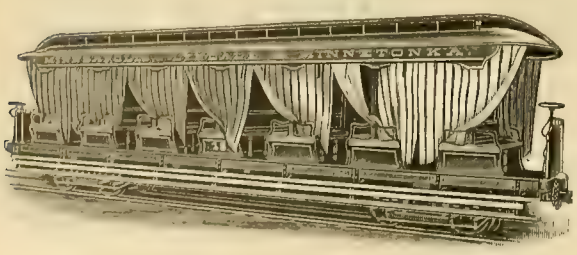

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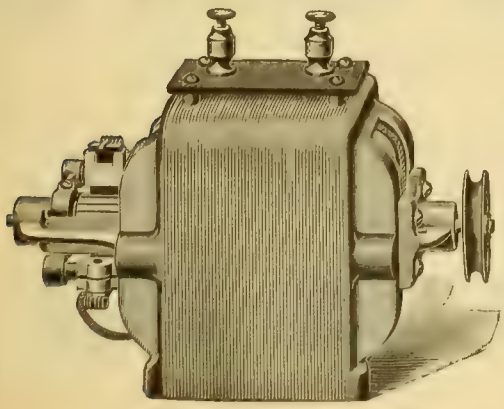

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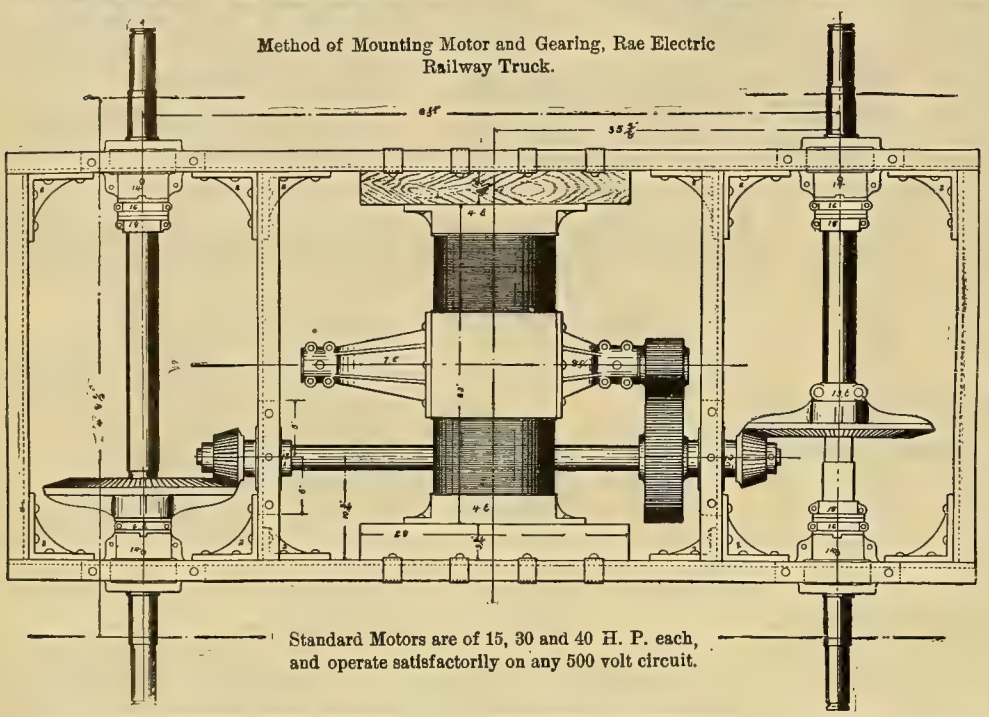

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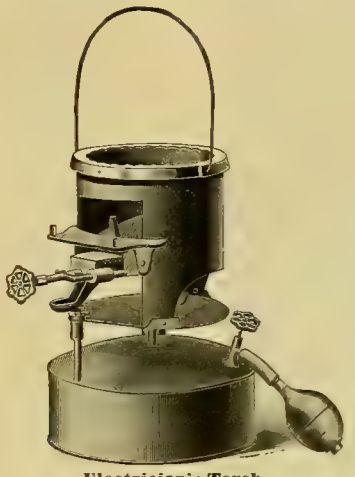

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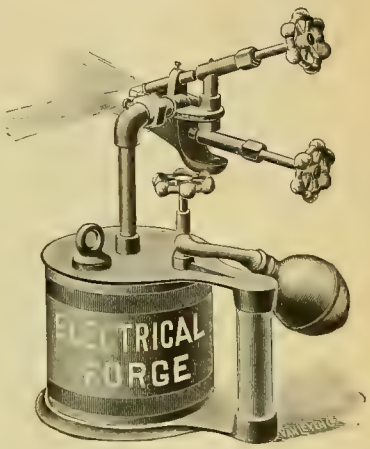

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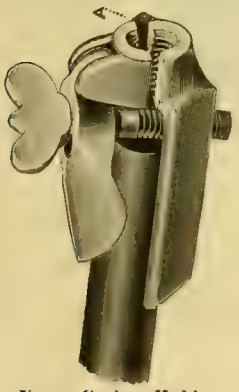

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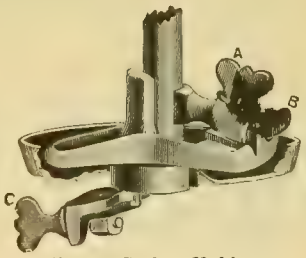

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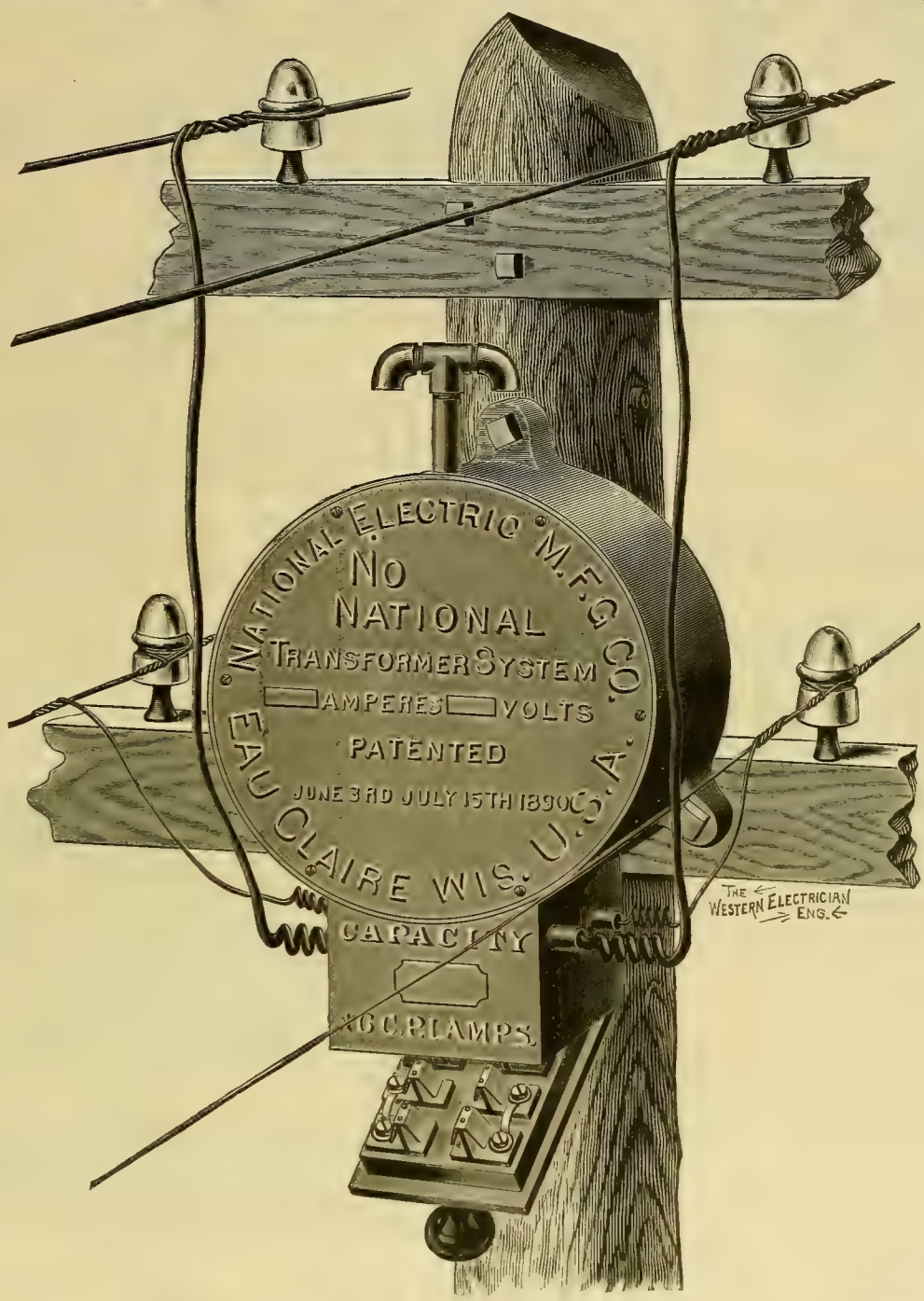

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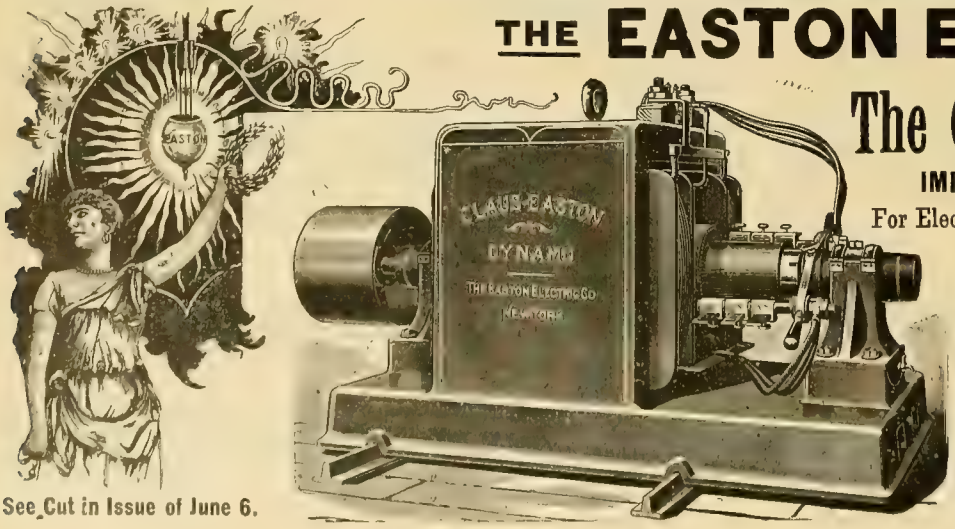

See Cut in Issue of June 6.

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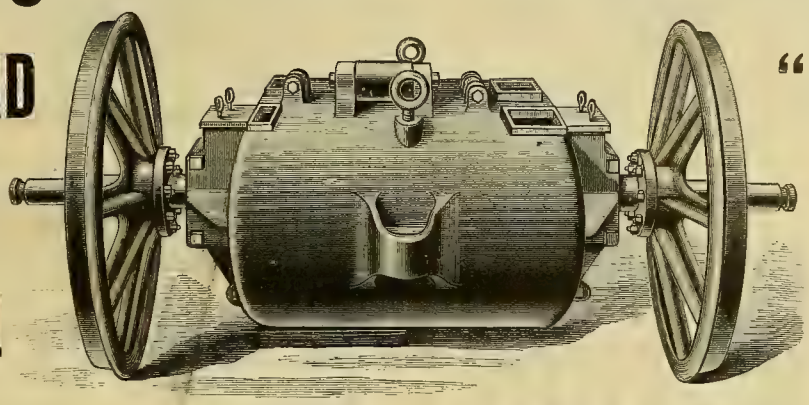

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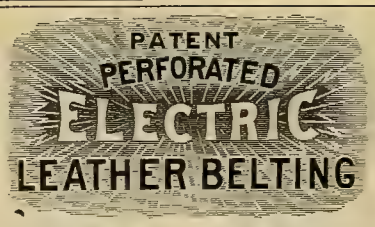

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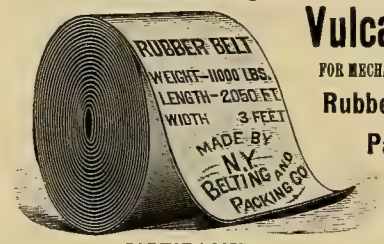

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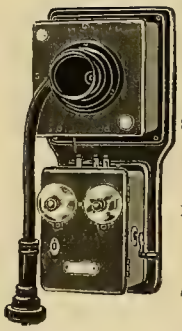

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Western Electrician.

EVERY SATURDAY.

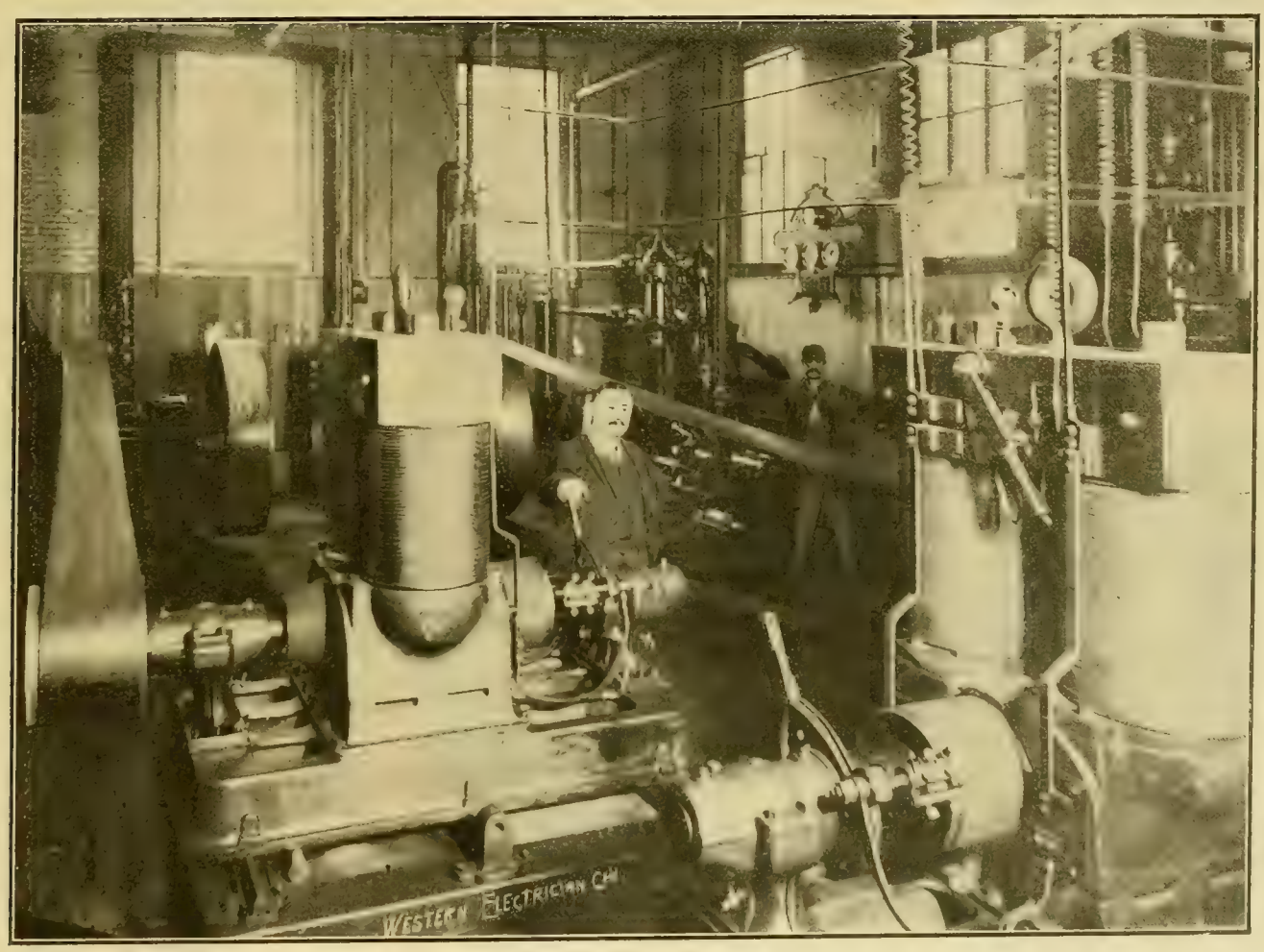
Vol. VIII. CHICAGO, MAY 30, 1891. No 22

Isolated Plant at the Hotel Portland.

In the accompanying cut is shown an illustration of the isolated plant of the Hotel Portland at Portland, Ore. It was installed by the Edison General Electric company, under the personal supervision of J. J. Bauville of the Edison company's engineering department, and reflects great credit on all connected with the installation. The plant is composed of two Edison compound and self-oiling dynamos, each of a normal capacity of 800 lights, and the hotel is wired for 2,240 lights. Electricity is used exclusively for illuminating the hotel, and it is claimed that there has never been a shut down since the plant started.

The dynamos are driven by Ideal engines, manufactured by Ide & Son of Springfield, Ill.

The plant throughout is considered one of the best in the country. It is the largest isolated plant west of the Rocky Mountains. The chandeliers and fixtures are all of special design, and were furnished by the Edison company. The plant is in charge of Charles Crook.



ISOLATED PLANT AT THE HOTEL PORTLAND.

Freaks of lightning form a favorite subject for the yarns of imaginative newspaper correspondents. A recent item is to the effect that "in a New Hampshire town the other night lightning took the tail feathers off twenty hens sitting on a roost and so paralyzed the vocal cords of the rooster that he has not been able to crow since."

Electrical Department, World's Fair.

Chief Burnham of the construction department has advertised for bids "for all the labor and materials that will be required to complete the electricity building for the World's Columbian Exposition in accordance with the plans and specifications, which will be on file in the construction office at Jackson Park." Bids will be received until 1 P. M. on June 1st, and undoubtedly the contract will be awarded a few days after.

The grounds and buildings committee of the directors has as yet taken no action on the resolution adopted by the board of control on May 2d, favoring a power plant for the Department of Electricity, in or adjacent to the electrical building. Some of the directors are discussing a plan by which the sites of the electrical and mining buildings can be exchanged. If this were done, there would be plenty of room for the desired power house in the space at the southwestern corner of the present site for the mining building, not a great distance from the "loop." This change, however, which is merely one of the possibilities under discussion, is largely dependent on alterations proposed in the arrangement of the space within the loop. Until this is settled the matter of a power house for the electrical building will be held in abeyance.

Commenting on the WESTERN ELECTRICIAN'S statement that the electrical building would be insufficient for the requirements of the department of electricity, the Rochester, N. Y., *Herald* says: "It is manifest that if any department should be generously treated it is the electrical. No other is more typical of American life and methods; in no other has there been such enormous progress within the past years; no other can produce a more brilliant and popular exhibition, and with no other are American genius and invention more closely identified."

In commenting on the failure of the authorities of the World's Columbian Exposition to make the desired changes in the electrical building at the World's Fair, the *Electrical Age* of New York, says: "It is extremely unfortunate that the electrical exhibit at the World's Fair to be held in Chicago will have to be scattered. The electrical people of Chicago made a good and earnest fight against it, but fate had decreed otherwise. The blunder is directly chargeable, as far as we can learn, to the committee on grounds and buildings, who did not listen to the wishes of the electrical people at the proper time, before settling upon building plans. The result is the building will be erected on the original plan, which, it was decided, could not be altered. While the electrical

fraternity will be greatly disappointed in not having the entire exhibit under one roof, they will do the best they can under the circumstances. If the building committee refuses to alter the plans, all that remains to be done is to make the best of a bad job. It is a great disappointment, and we think a great mistake has been made by the building committee."

The *Western Machinist* says: "The WESTERN ELECTRICIAN is very justly kicking hard against this plan of structure, on the ground that it will be inadequate. It is to be hoped that a building of sufficient capacity will be substituted for the one proposed."

The Power Station of the Davenport and Rock Island Railway Company.

The street railway systems of Moline, Rock Island and Davenport have been in operation for a number of years, but the benefits which should have been derived from the lines were curtailed by the failure of the three corporations to work in unison. When, however, the Chicago syndicate, under the direction of C. B. Holmes, purchased these companies, an amalgamation of interests became possible which otherwise could never have been brought about. All former attempts to secure a line across the bridge by any one company was the signal for every possible obstruction from all the others; but, when an outside syndicate came in and merged the whole into one, the greatest difficulty was overcome. The consolidation of rival interests accomplished what was never before possible, namely, connecting the two cities by a street railway line and securing from the government authority to lay tracks and operate cars across the island and over the government bridges. The advantages, however, are invaluable. Formerly a passenger in Davenport was obliged to take a car to the ferry, another line in Rock Island, and still another in Moline, making three transfers and four fares to reach Moline. Now, the resident of any one of these cities can take a car and go through without change to any of the others and for only one five cent fare.

The electric road crosses the river on two bridges, both of which belong to the government, which shares them with the Chicago, Rock Island & Pacific railway. The bridge on the Iowa side is 1,848 feet in length, divided into five spans and one draw, which is 368 feet long. It was an interesting matter as to how the trolley and feed wires should be carried across the draw, but this was at last solved by the erection of three towers, one at the piers at either end of the draw, and a third in the center of the draw itself. The draw tower is 125 feet above the water, and has a fixed frame, on which the wires rest, the frame being stationary and hung on a swivel which turns with the draw. This height is ample to keep the wires out of reach of the stacks of the highest steamboats. A feed wire is brought down from the draw tower and supplies the trolley wires which extend to either end of the draw on both tracks, so that when an electric car passes from the draw to the main spans the trolley wires are practically continuous.

The electric railway tracks pass across the island almost at the water's edge, and reach the Illinois bank by a second bridge, which is 600 feet long. The bridge is double-decked, the steam road occupying the upper portion and the electric cars and other vehicles and pedestrians use the subway.

Although the company's power house is in Illinois, it finds the necessity for ample car house facilities in Iowa, and has therefore erected a handsome brick structure in Davenport This building is 128 feet front by 150 deep; 16 feet high the first story, 13 in the second, and has a storing capacity for sixty cars. A large elevator quickly raises a car to the second story, where there is still more storage room. On this floor and extending the entire length of the building on the Rock Island street side, are paint, repair and machine shops. Power for operating the elevator and machine shop is furnished by an electric motor, which takes its supply from the same wire which feeds the trolley wires. A most convenient and somewhat novel feature of this car house, is an elevated platform, Fig. 1, under which a car is run for examination or repair of the trolley. This platform is so placed as to clear the roof of the car by several inches, and is divided lengthwise to allow the pole to maintain contact with the overhead wire.

The Moline car house is one story high, 106x168 feet and is located on Fifth avenue and Thirty-first street.

The equipment of the system consists of fifty sixteen foot motor cars and seventy trail cars. These cars are from the shops of the St. Louis Car company, and some from the LaClede shops. Three incandescent lamps in the center and one at each end brightly illuminate each car at night, while 14 incandescent Star headlights lighten up the gloom without. Adjustable wire gates inclose the platforms and wooden fenders guard the wheels. The wheels are from the well known Griffin Car Wheel company, and are 36 inches in diameter, with chilled tire. The trucks are of forged steel, and were all built for this order by the McGuire Manufacturing company, Chicago. Of the motor cars, twenty-two carry one 20 horse power motor each, and eighteen are equipped with 30 horse power motors, the latter to be used in drawing trains. The heaviest grade on the entire system is in Davenport, and is 10 per cent.

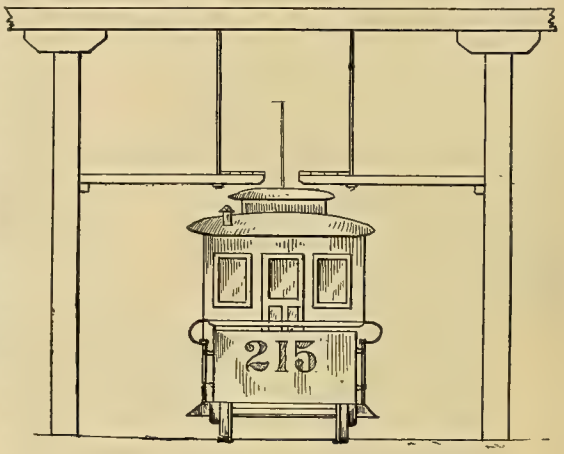
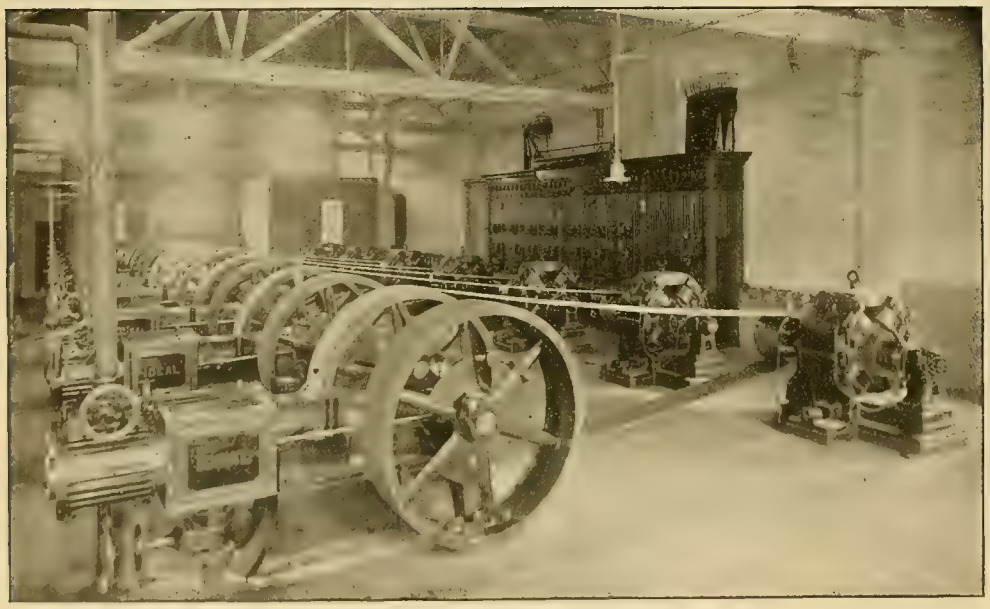


FIG. 1. DAVENPORT AND ROCK ISLAND RAILWAY COMPANY.

In Rock Island, a short distance from the river and facing it, is the power plant. The building is on Second avenue, and is 105x115 feet, divided into two sections, which extend its entire length, by a fire-wall reaching to the roof. On one side is the boiler room, 54 feet from floor to roof. The steam plant consists of a battery of three Hazelton tripod boilers arranged in a row and equipped each with a Roney mechanical stoker. The cheapest grade of Illinois slack is used for fuel, and the combustion is so perfect there is little or no smoke. The engine and dynamo room are illustrated herewith. There are seven 125 horse power Ideal engines, resting on brick foundations, which in turn rest on bed rock. Each engine drives one generator, resting on a six foot foundation. Five engines will furnish the maximum power required at present, leaving two engines and two generators always in reserve. The generators are multipolar 75,000 watt machines, built and installed by the Thomson-Houston company, wich had the entire contract for all the electrical work throughout, including the motors. The installation was made by Mr. Willard.

Each engine has two driving pulleys, 72 inches diameter; only one is belted, the other serving as an additional fly wheel. The dynamo pulleys are 23 inches in diameter, and the distance from center to center of engine and dynamo pulleys is 18 feet. The engines make 240 and the generators 750 revolutions per minute. The belting is 3-ply cotton, leather face, made by Underwood. A 10,000 watt exciter is run by an independent 7x10 engine running at 270 revolutions per minute. The engines are compound condensing, the high pressure cylinders being 12x20 inches, and the low pressure 14 x 20 The generators are each furnished with a line switch, an ampere meter and an automatic circuit breaker. All the electrical power required to operate the cars of this company in the three cities is supplied from this one central power station, the current being conducted on five main circuits. The circuit to Davenport crosses the bridge, but it is not made to feed until it reaches the Iowa side. Here it has branch feed wires like the fingers of a hand. The feed wire which supplies Moline is also carried intact and not tapped along the route.

The main switch-board is built of oak and brass, 14 feet high, and 25 feet long. The feeder switch-board is the same height, but only 10 feet long. Each of the five circuits is fed independent of all the others, so that any disarrangement to one line has no effect upon any of the others. Okonite wire of three-quarter inch diameter carries the current from the machines to the switch-board, and braided okonite wire is used for the back of the board. The cuts are from the *Street Railway Review*.



POWER STATION OF THE DAVENPORT AND ROCK ISLAND RAILWAY COMPANY.—DYNAMO ROOM.

Many of the country seats for which England is famous are lighted by electricity. Thus *Industries* of London states that the Earl of Durham has decided to thoroughly reorganize the electric lighting arrangements at Lambton Castle. An entirely new electric generating plant, comprising two Cornish boilers, each of 25 horse power, and two of Parsons' steam turbines and dynamos of the new improved type, with automatic expansion, each capable of supplying 32 kilowatts, is to be erected.

Mammoth Dynamos for Central Station Work at Paris.

As a supplement to an article in the WESTERN ELECTRICIAN for March 21st there is presented herewith a perspective view of the large station of Rue des Dames de Batignolles at Paris, where the mammoth dynamos previously referred to are in operation. The construction of these dynamos was described in the former article, but the distribution and regulation of the plant deserves further attention.

In Fig. 1. are seen two of the Corliss engines and one of the smaller dynamos. To the right is shown part of the switch-board, built as a partition in the center of the engine hall,

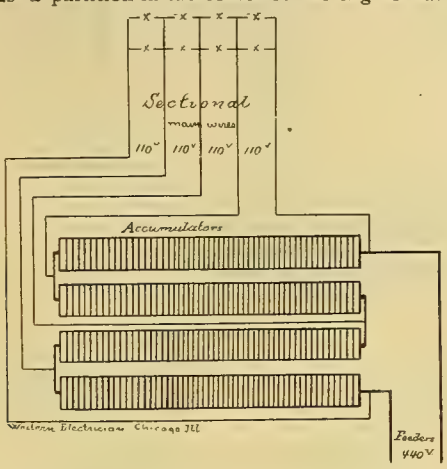


FIG. 2. MAMMOTH DYNAMOS FOR CENTRAL STATION WORK AT PARIS.

and surrounded by two galleries reached by two spiral stairways. The cables from the dynamos are carried underground to the center of the partition and are there connected to switches, rheostats and meters, so that no wires are visible anywhere on the board. The lower gallery is utilized exclusively for regulating and coupling devices for the dynamos. The conductors from each of the machines are joined to a set of heavy copper bus bars, extending along the wall. Double switches with fuses serve to connect or disconnect each dynamo. The exciting current for the fields is taken from the bus bars through rheostats for each dynamo, and these resistances are so connected that the dynamo tender can regulate the tension of each dynamo separately, or can by a joint lever movement change at once the electromotive force of the whole system. A voltmeter indicates the difference of potential between the bus bars. To test the electromotive force of each dynamo separately and at any time, another voltmeter is so connected with a switch that it can be thrown in circuit with any of the dynamos. Amperemeters, also arranged on the board, indicate the current developed by each dynamo as well as the total number of amperes passing through the bus bars.

On the second gallery is located the distributing switch-board, which is furnished with the necessary instruments for indicating the current passed through and the pressure maintained in each set of feeders. As has already been stated, the difference of potential between the bus bars is 440 volts. To obtain a working current of 110 volts in the service wires the five wire system is resorted to. The feeders carrying current at 440 volts from the distributing switch-board are run underground to different stations of distribution located at various distances from the generating station.

At the sub-station the actual distribution and equalization of the current in the different sections is carried on. A battery of 200 accumulators, joined in series, is charged directly from the feeders. The battery is divided into four sections of 50 cells each, Fig. 2, and a wire is joined to each of the two main poles and also to the three intersections of the battery, making five wires or four divisions. The difference of potential of 110 volts between wire and wire is thus obtained. The battery is kept fully charged and develops a counter electromotive force of about 2.3 volts for every cell. If all the four sections are equally loaded, the difference of potential at each intersection of the battery is the same. If the loads on the sections are unequal, the potential tends to increase at the sections of least consumption, and diminish at the sections of greatest consumption, but as there is maintained a distribution of lamps as near as possible equally divided among the four sections, only an immaterial variation in the system takes place. In some stations the accumulators are replaced by a regulator, which serves the same purpose of subdividing the 440 volts current into 110 volts at the sections. The machine which is represented in Fig. 3 is constructed mainly on the principle of Elihu Thomson's compensator. It is practically nothing but a quadruple dynamo, having four armatures mounted on the same shaft and having brushes bearing on a commutator at the side of the armature. The armatures are connected in series, and the five sectional wires are tapped on at the brushes. The exciting current for the fields is taken direct from the 440 volt feeders and is passed through all the magnets in series.

If the four sections are equally loaded and are carrying a full charge, only a slight current will pass through the armature of the regulator, rotating it at a slow speed, just enough to overcome the friction of the bearings. When a variation of load on the sections occurs, the four armatures of the regulator will be traversed unequally by the current, that is, the armature belonging to a section of light load will get a larger amount of current, while the armature connected to a section of heavy load will receive less current than normally. As the armatures of the regulator are alike electrically, the conse-

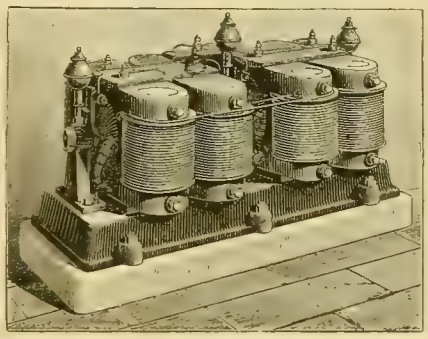
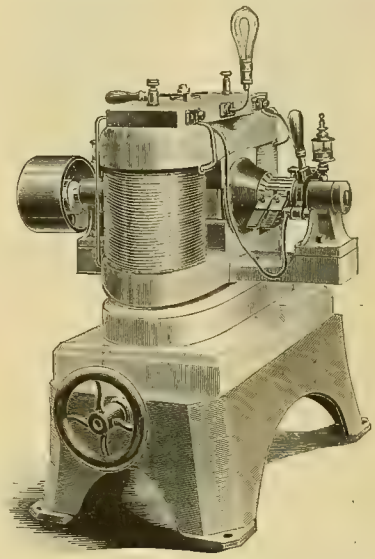


FIG. 3. MAMMOTH DYNAMOS FOR CENTRAL STATION WORK AT PARIS.

quence will be that the armature receiving the larger amount of current will increase the speed of the machine, thus acting as a motor, while the armature with the weaker current, being rotated at an increased speed, will become a generator and furnish an additional current to its section. The difference of potential in the whole system is in this way re-established. The cuts are reproduced *La Nature.*

The Star Electric Company's New Dynamo.

The accompanying cut represents a new 150 light compound constant potential generator manufactured by the Star Electric company of Cincinnati. The field magnet of this machine has in its core but two joints, and these are scraped to a perfect fit. The field coils are wound on sleeves so that they may be easily slipped on the cores. By an improved method of winding the armature wire is left with no sharp crosses or crooks in the coils at the end.



THE STAR ELECTRIC COMPANY'S NEW DYNAMO.

Each coil as it is wound takes relatively the same direction as that of the preceding one. In this manner the wires are not bunched at the end of the Siemens armature, but take up less space than is the case where the ordinary method of winding is employed. The manufacturers consider that their method of constructing an armature enables them to produce a perfectly balanced structure. But one layer of wire is used on all the various sizes of the Star machines, so the gap between the core and the faces of the pole pieces is comparatively small. The armature shaft is of hammered steel, and runs in phosphor bronze bearings of the ball and socket type. A variation in load from one lamp to the full capacity of the machine makes but a momentary difference of about 1.5 volt in the meter, and, it is claimed, sudden changes of load produce no sparking whatever. These machines are built for any voltage, and in sizes as high as 600 lights' capacity.

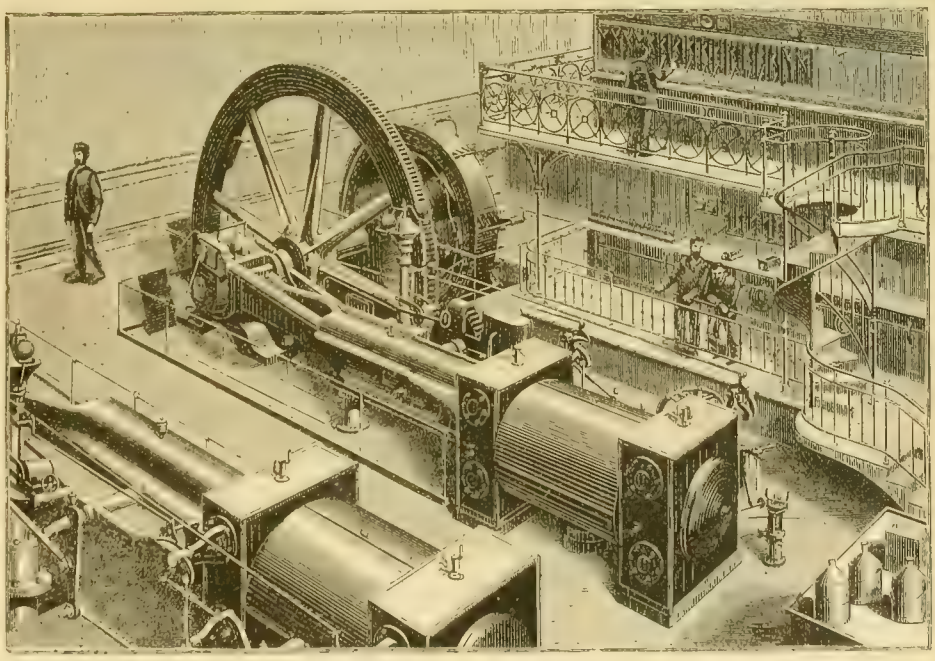


FIG. 1. MAMMOTH DYNAMOS FOR CENTRAL STATION WORK AT PARIS.

An Electric Stove and Generator.

Although the production of electricity through the agency of heat is by no means a new phenomenon, the development of the process has not been very rapid. Even the latest experiments in this line, utilizing gas as a generating

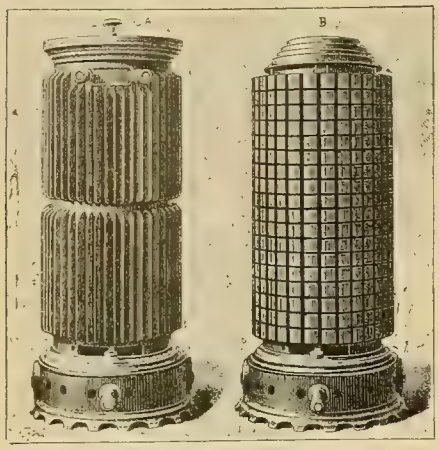


FIG. 1. ELECTRIC STOVE AND GENERATOR.

medium, have not shown results which would tempt investors.

According to authorities, the most economical results yet obtained still show a consumption of one cubic foot of gas per watt-hour or 1,065 cubic feet per kilowatt hour. Inventors, however, are working at the problem, and the cuts illustrate one of the numerous attempts at a practical solution.

This electric stove was devised by M. le Dr. Giraud. The apparatus was designed with the view of utilizing the fuel not only for general heating purposes, but also as a means for generating current. Fig. 1 is a general view of the stove with the outside shell or cover removed, exposing the elements of the thermo-electric pile. The pile consists of 700 pairs of plates, divided into 25 concentric rings, occupying the entire space from the base to the crown with the exception of an outlet for a pipe which carries the product of combustion to the chimney. The plates consist of a nickel or sheet-iron piece for the positive pole and an alloy of antimony, zinc and a small proportion of other metals for the negative pole. As it is the peculiar combination of metals

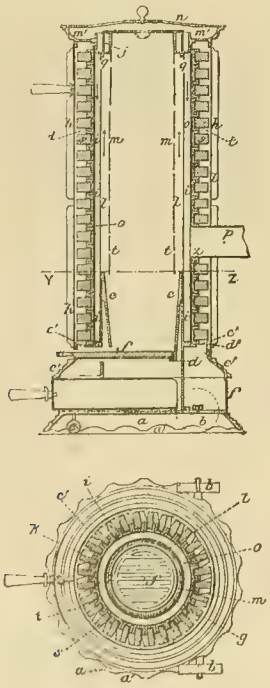
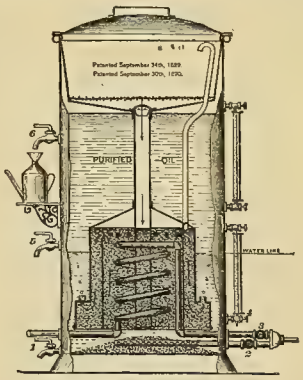


FIG. 2. ELECTRIC STOVE AND GENERATOR.

upon which the invention is based, the composition of the negative plate is not divulged. All the elements of the pile are connected in series and the circulation of the burning gases is directed in such a way that the heat developed is evenly distributed over the whole inner surface of the pile. On account of this arrangement the lower elements do not attain to any higher temperature than the upper part of the pile, so there is maintained an even electromotive force in each pair of plates. The necessity of obtaining an even temperature throughout is evident, for if that part of the pile which was exposed to the highest temperature would develop a greater electromotive force, those elements which were less heated would act as a resistance. The output of the thermo-electric pile, with nickel electrodes, is claimed to be a current of four amperes at 40 volts on a short circuit, or at the most economical rate of discharge, 40 watts. This output is with a normal consumption of fuel. By closing the draft and checking the combustion, the capacity decreases to 35, 30 and even 25 watts. If the stove is kept at a normal rate of combustion during a day, it is said that an accumulation of 800 to 1000 watt-hours can be attained. It is stated that a thermic pile, with sheet-iron electrodes instead of nickel, will give at normal temperature 5 amperes with an electromotive force of 35 volts at short circuit.

Fig. 2 gives a sectional view of the stove, of which the principal features are as follows: *f* represents the grate, *e* the fire pot, *l*, *g*, *i* flues for conducting the heat to the electric pile, *s* the metallic elements of the pile, c^1, *t*, m^1, *n* air



NEW OIL PURIFIER.

canals for cooling the elements, *p* pipe as outlet from the flues to outside shell.

At a series of experiments made with this stove at Paris the consumption of fuel did not exceed, it is said, 56 pounds of coke per day. The cuts are reproduced from *La Nature*.

New Oil Purifier.

Large quantities of lubricating oil are used in every electric light plant in the country, and therefore central station people generally will be interested in the new Perfection oil purifier shown in the accompanying illustration. J. Bigler of Newburgh, N. Y., is the inventor. The device works automatically. The oil runs through the center tube, below the water, passes around the steam coil, and then, being somewhat diluted, will drop the impurities. After further process it will finally gather above the line ready for use. John Oakley of Chicago is the general western agent. The purifier is used by several Chicago electric companies.

Aluminum Shade.

The accompanying cut illustrates a neat little incandescent shade made of aluminum, and placed on the market by the Electrical Supply company of Chicago. These shades are especially desirable for decorative purposes and when grouped in show windows, for instance, against a background of velvet in Indian red, gamboge or orange, the effect can readily be imagined. The device is of course extremely light, a feature of no little importance in this work.

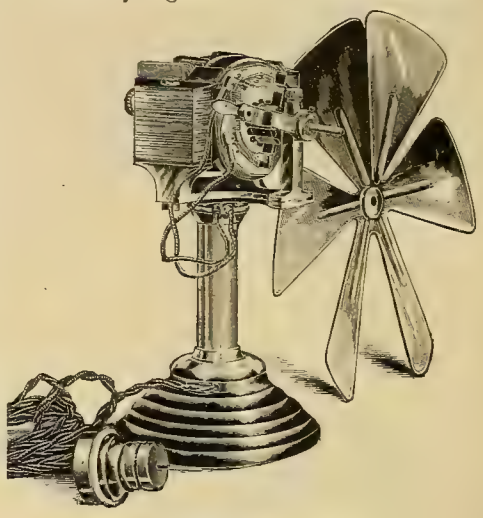
New Westinghouse Fan Motor.

The Westinghouse Electric & Manufacturing company is constructing a fan motor which possesses many advantages. It can be successfully used on an alternating current circuit.

One of these motors was placed in the company's office last November, where it has been running without interruption for six months. During all this time it has required no attention whatever.

The armature coils and the wires leading from the armature to the commutator are completely embedded in a cementing material. This method of embedding the delicate parts of the apparatus precludes all danger of short circuiting, and it obviates any breaking of the wires by rough handling.

The speed of the Westinghouse fan motor can be easily regulated. The motor has two



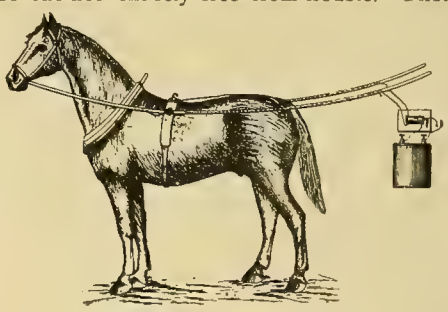
NEW WESTINGHOUSE FAN MOTOR.

carbon brushes, which are set so as to work automatically; at the same time they need not be renewed for years. A moving of these brushes to the left or the right causes the armature either to revolve fast or slow.

Apart from the usefulness of this little apparatus, it is also highly ornamental. The fan is nickel plated, and the stand on which it is mounted is of brass. The fan motor can be moved about to any part of the room, as it only weighs about nine pounds.

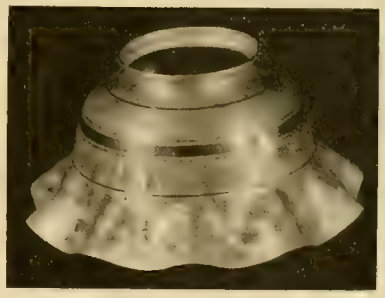
Electricity as an Incentive.

The lot of our equine friend, since electricity trespassed upon his domain, seems destined to be one not entirely free from trouble. First,



ELECTRICITY AS AN INCENTIVE.

owing to the introduction of electric motors for propelling street cars, he has been compelled to seek employment elsewhere. Not satisfied, however, with driving the cars by electricity, an inventor seeks, through the same agency, to drive the beast himself. A Chicago man, Albert B. Holson by name, has recently come to the front with a scheme "whereby an electric shock may be given to the horse carrying the harness, to which the device is attached, whenever the driver desires."



ALUMINUM SHADE.

The apparatus used by the inventor and the manner in which he applies it to the horse are shown in the illustration. A one cell battery, an induction coil, a push button on one rein and wires passing through the reins to metallic contact pieces on the under side of the harness saddle—this is the combination

Armature Reaction in Constant Current Dynamos.[1]

By Professor H S. Carhart.

The experimental work of a laboratory of electrical engineering convinces the observant investigator that the literature of dynamo-electric machinery is not only deficient in matters pertaining to constant current machines, but contains reiterated statements that are wide of the facts.

Thus, we are told that regulation by means of the movement of the brushes round the commutator cylinder is

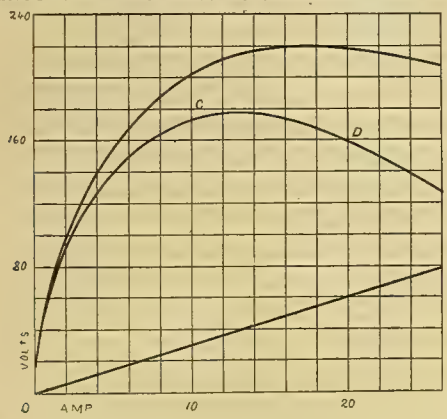


FIG. 2. ARMATURE REACTION IN CONSTANT CURRENT DYNAMOS.

impracticable because of the destructive sparking that ensues, while the fact is that with machines having a closed coil armature, and particularly those of the Gramme ring type, the current may be kept constant from full load to no load by rocking the brushes forward without any appreciable sparking. The explanation of this remarkable method of regulation is the enormous influence of the armature on the magnetic circuit of the machine. At the same time it mu t be confessed that uniformity of field contributes to the result, but great uniformity is not essential.

My remarks will be directed, not so much to the explanation of the sparkless commutator of a machine which regulates by rocking the brushes round the commutator cylinder, as to the part played by the magnetism of the armature of a constant current dynamo.

In the ideal simple dynamo the lines of force are supposed to traverse the inter space lying in their path between the polar faces and the armature core with almost perfect uniformity in every part. But it is well known that this is only approximately true even when the field magnet is independently excited and the armature is at rest with no currents flowing through it. A deformation and redistribution of the lines of force begin as soon as the armature is set in rotation, unless the lamination is carried to an extreme, and the brushes are not down so as to short-circuit sections of the coil as they pass under them.

With the machine self excited, and the external circuit closed, so that a current circulates round the armature, then the "battle of the giants" begins. For the armature core is magnetized both by the induction from the field and the current circulating through its own coils. In other words, the flux of magnetic force through the armature is the result of two magneto-motive forces. The relative influence of the one generated in the armature itself will depend upon the design and construction of the machine in a manner which I shall now proceed to explain.

Constant potential dynamos and constant current dynamos possess diametrically opposite properties in these particulars which affect armature reaction.

It is essential in the first place that the armature resistance of the former should be reduced to the lowest limit

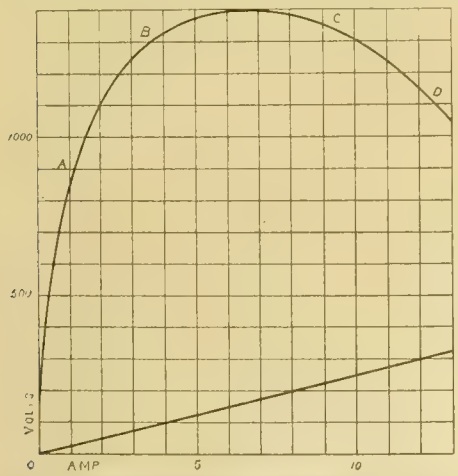


FIG. 1. ARMATURE REACTION IN CONSTANT CURRENT DYNAMOS.

of making a very intense field and by reducing the convolutions of wire to as small a number as possible, hence the magnetic effect of the armature is reduced to small limits for this reason.

[1]Read before the Chicago Electric Club, May 25, 1891.

Again, every builder of dynamos knows that the field cores and pole-pieces of constant potential machines should be heavy in comparison with those of constant current machines. The iron in such machines must be kept below the so-called saturation point, even at full load, so that the field will respond by the series winding to the increasing load with additional lines of force, and thus make up for the increased loss of potential in the armature. Whenever, therefore, the current increases in such a machine, the field magnet responds to the increase to an extent fully equal to that of the armature. The relative influence or reaction of the armature is thus kept within narrow limits.

The well-designed constant current machine is very different from all this. Fig. 1 is a "characteristic curve" made from a 25 light machine with a Gramme ring. It is simply a curve drawn with the currents and the volts at the terminals as co-ordinates. This curve exhibits both the saturation of the field magnet cores and the reaction of the armature. It will be observed that at 10 amperes the

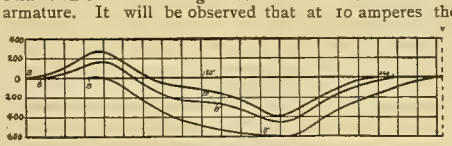


FIG. 7. ARMATURE REACTION IN CONSTANT CURRENT DYNAMOS.

curve is well over its maximum and the reactionary droop has set in. Such a curve, when corrected for internal loss of electromotive force, represents approximately the curve of magnetism of the field.

Now, a constant potential machine works on the rising part of the curve, as from *A* to *B*, so that the field magnet may respond promptly to the rising current. The magnetism is just at that exquisitely sensitive stage when it feels every change in the current, and when the permeability has a nearly constant value. The constant current machine, on the other hand, works preferably to the drooping part of the curve between *C* and *D*. It thus becomes in a measure inherently self-regulating or automatic: for any increase in the current actually diminishes the electromotive force, thus checking the rise of current, while a decrease of current causes the point traversing the characteristic to move backward along the curve and thus

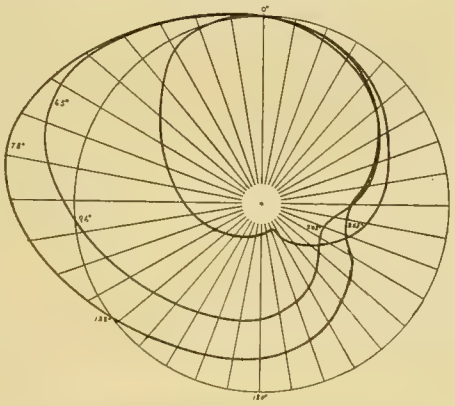


FIG. 5. ARMATURE REACTION IN CONSTANT CURRENT DYNAMOS

upward. The consequent rise of voltage tends to sustain the current at its normal value. This feature of a constant current machine permits of larger armature reactions, and moreover, gives to the machine that stability so essential to prevent surging when the machine is run on arc lights. If the machine were working on the outer side of the bend or crown of the curve, any sudden increase in lamp resistance at the carbons, such as often occurs, reduces the current and so reduces the ampere turns round the field magnet, thus causing the point denoting voltage to run rapidly down the curve on the left. The trouble is thus cumulative and the machine drops its load by losing its excitation, to recover it again only after the

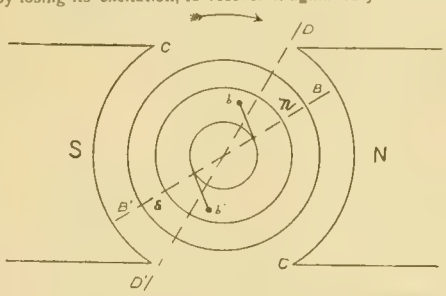


FIG. 4. ARMATURE REACTION IN CONSTANT CURRENT DYNAMOS.

carbons have dropped together. The drooping characteristic gives to a series arc machine a stability and self-control which enables it to check small irregularities of circuit resistance. The field magnets of such a machine are not greatly sensitive to moderate changes in the current. It possesses that self-corrective property so essential to steady working on good arc lamps.

The characteristic of Fig. 2 illustrates a different design and a different state of facts. It was taken from a machine with a gramme ring, built in Ann Arbor in the early spring of 1877, after designs of Prof. J. W. Langley. It has a capacity of fully 5,000 watts at a speed of 1,400 revolutions. So far as I have knowledge this was the largest dynamo machine built in this country at that date. Viewed from the standpoint of present knowledge and experience, it is faulty in design and of inferior workmanship; but when built, it embodied the latest facts known to the art.

It will be observed that at ten amperes the field is not up to the saturation point, and the curve has not begun to bend over. Hence this machine serves to illustrate the quality of instability when run on ten ampere arc lamps. The current runs with remarkable periodicity up to a max-

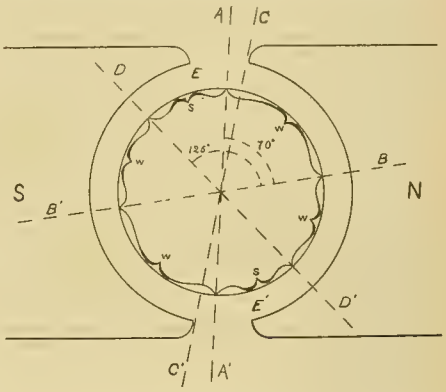


FIG. 6. ARMATURE REACTION IN CONSTANT CURRENT DYNAMOS.

imum of about twelve amperes depending upon the position of the brushes, and then down to zero, when the carbons all drop together and the field again builds up. It would run low tension lamps successfully without doubt, though I have not had the opportunity of trying it. At eighteen amperes the working part of the characteristic would lie well over the crown where the field possesses greater stability. The lower curve is the external characteristic, and the upper one that of potential differences at the brushes. The core of the armature of this machine consists of iron wire; the field magnet cores are composed of six flat plates of wrought iron, while the yoke and pole pieces are cast iron. The commutator has only twenty six segments, but the sparking is slight.

To test the effect of the armature currents on the voltage, the field was excited by a separate machine, first with five amperes and subsequently with ten. With a fixed position of the brushes the external resistance would gradually diminish, while the current taken from the armature increased. Now if there were no reactionary influence of the armature, the curve connecting together amperes and total voltage generated by the machine, including the loss in the armature, should be a horizontal line. The actual curves for the two conditions of excitation of the field are given in Fig. 3; the lower was obtained with the five amperes in the field, and the upper with ten. The actual drop in potential with the smaller excitation was 37.6 volts and with the larger 33.4; but the percentage of depression in the two cases was 23 and 15.7 respectively. Thus, as anticipated, a relatively weak field shows the greater modification and distortion due to the armature currents. The difference in the two curves is shown by the superposition of the lower on the upper as a dotted line.

The nature of the armature reaction may be made out partly from theory and partly by means of appropriate experiments. So far as the direct influence on the field is concerned it is referable to two quite distinct factors, which may be expressed in terms conformable to the modern method of analyzing a magnetic circuit. This consists in expressing the magnetic flux as the quotient of the magneto-motive (M. M. F.) force and the magnetic resistance. The currents circulating round the armature reduce the magnetic flux both by increasing the magnetic resistance or equivalent length of the magnetic surface and by generating a counter magneto-motive force. The former is affected in just that portion of the circuit where the resulting change is the greatest, that is, in the air interspace adjacent to the polar faces. The lengthening of the magnetic circuit in the vicinity of the polar margins CC_3 Fig. 4, was well illustrated and suitably enforced by Mr.

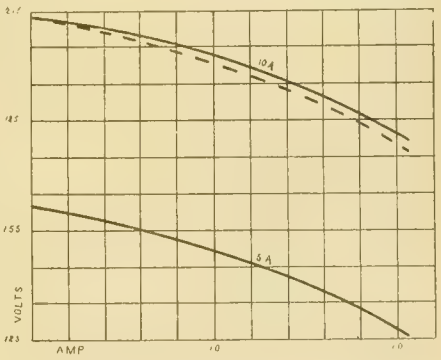


FIG. 3. ARMATURE REACTION IN CONSTANT CURRENT DYNAMOS.

Dow in his paper before this club on April 6. The other factor appears to play a much more important part in regulation by motion of the brushes than the deformation of the field at the polar tips; for by means of it the brushes may be kept nearly sparkless from full load to short-cir-

(*Continued on page 307.*)

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F. L. PERRY, - - - - - - - - - - - }
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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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DESPITE the repeated protests of the entire electrical fraternity, the Construction Department of the World's Columbian Exposition with the approval of the local board of directors, has advertised for bids on the electricity building according to the specifications and drawings prepared under the direction of Chief Burnham. This means that inadequate provision will be made for the Electrical Department, and in a measure at least, the fair will be a failure. The electrical building, as we have repeatedly pointed out, will not begin to accommodate the electrical people. Nobody is satisfied with the present arrangements, excepting Mr. Burnham, but as he seems to be the only person whose wishes the directors consult, the proposed plans will in all probability be adhered to, and the building constructed according to his views.

The latest scheme for securing a change in the electrical building, with a view of securing more space, was proposed last week, when it was suggested that the electricity and mines buildings be transposed. This arrangement it would seem would give the department an opportunity to build an addition and also place it nearer the power plant. Whatever arrangement is made it should be borne in mind that the representatives of the electric interests have served ample notice on the directors, and have repeatedly warned them of the folly of adhering to the present arrangement. Everything possible has been done to bring the directors to a realization of the mistake they were making, but all to no purpose. They are equally responsible with Mr. Burnham for the present condition of affairs. This fact should not be forgotten.

PROF. H. S. CARHART'S paper on "Armature Reaction in Constant Current Dynamos," read at the last meeting of the Chicago Electric club, was undoubtedly one of the ablest papers presented to that body during the season. Striking out from beaten paths Prof. Carhart recounted an original line of investigation which seems to disprove certain existing theories relative to the constant current dynamo. He referred particularly to armature magnetism, and stated his conviction as to what were the conditions requisite to securing a sparkless commutator with varying load and shifting brushes. "A fairly uniform field, with pole pieces not too heavy, and an armature magnetically powerful relative to the field," with the field magnet "magnetized to such an extent that it is no longer greatly sensitive to moderate changes in current"—such are the conditions set forth by Prof. Carhart, under which he looks for the most favorable results in the maintenance of a normal constant current.

IN the discussion which followed the paper on "Electricity in the Production of Aluminum," recently read by A. S. Brown before the American Institute of Electrical Engineers, Prof. F. B. Crocker made some assertions relative to the qualities of aluminum which were not well received by those interested in that metal. In this issue Charles M. Hall, in an article on "The Properties of Aluminum," takes Prof. Crocker to task in a lively manner. Mr. Hall claims to have had considerable experience with the metal, and his criticisms of Prof. Crocker's statements will be read with interest. In the introduction to his remarks he says that the professor's "statements regarding the properties of aluminum are so wide of the mark and so misleading that they ought, in the interests of sound information, to be corrected." Mr. Hall does not beat around the bush. He talks plainly and evidently speaks his convictions. Prof. Crocker's reply will be awaited with interest.

IN connection with the installation of the electric light plant in the Royal castle, Berlin, illustrated last week, it is worthy of note that the only system of illumination considered as a substitute for wax tapers was electricity. There were of course many considerations which influenced those whose duty it was to solve the problem. Throughout the Royal castle there were many valuable works of art which would be damaged if gas were employed. Moreover, the costly drapings and furniture would suffer, it was asserted, and the richly ornamented ceilings could not be shown to such advantage as with electric lights. All these considerations combined to make electricity the favorite method of illumination. Then again the question of safety entered. It was recognized that with first class construction such as might be expected in this plant there was almost a total absence of danger from fire. Another advantage of no little importance was the superiority of electricity over gas in the matter of personal comfort. In crowded reception rooms and banqueting halls illuminated by gas there is always an oppressive heat despite all attempts at ventilation, but with incandescent lights the absence of heat is quite noticeable.

THE city of Toronto has engaged in the business of operating the street railway lines of that city. This is an important step, and the result will be watched with interest. It is not to be presumed that Canadian politics have attracted a higher class of men than those engaged in conducting the affairs of the municipalities in the United States, and it is to be feared that the people of Toronto have made a serious mistake.

Men of wide experience in this country oppose all measures of this kind. Delegates to the "Third Party" convention at Cincinnati last week found food for reflection in an interview with Senator Carlisle on this topic. They questioned him on his position, and, when they admitted that to confiscate the property of corporations could not be justified, he said: "Then you must buy them, and to buy them you must pay for them, and to pay for them you must tax yourselves. Have you any idea how much it would cost? Our government debt at the close of the war was more than two thousand millions, and we have been almost thirty years in paying half of it. The railroads, telegraphs, telephone lines and steamboats in the country represent about $10,000,000,000 invested capital; $4,000,000,000 is bonded indebtedness which must be paid. Are you ready to tax yourselves to raise this money? Then, after you have got the property, are you ready to tax yourselves to operate it, for the government never yet succeeded in doing business at a profit? Consider another effect; such a plan would add perhaps 1,200,000 men and women to the roll of government employes. How would you ever succeed in turning out of power an administration with such resources at its command? The more corrupt it was the more difficult it would be to displace it."

IT is generally recognized that nothing succeeds like success. The truth of the saying could not be better illustrated than in the change in the attitude of the London *Electrical Review*, as shown in the issue of May 8th. The following paragraphs on Ferranti's high tension work in London appear: "It must be said, however, that the work has been executed with a boldness that is startling, and we cannot withhold praise for the manner in which almost insurmountable obstacles have been overcome. But Mr. Ferranti had a 'free' hand, and was backed up by a fearless and confident body of directors, whose downright honesty of purpose, despite our adverse criticism, we have never impeached. If success was ever deserved it is in the case of Mr. Ferranti and the London Electric Supply corporation. * * *

"It must therefore be acknowledged that up to now Mr. Ferranti has been perfectly successful with his cables."

It is amusing to note how completely our contemporary has changed in its references to Mr. Ferranti's work. For over a year we have watched with the greatest interest and admiration Mr. Ferranti's noble efforts in developing a system the like of which this country has never seen. We appreciated the fact that Mr. Ferranti had undertaken a gigantic enterprise, and one in which innumerable and seemingly insurmountable obstacles would arise. Problems had been solved which were apparently as difficult as those which confronted the "young man"—as Mr. Ferranti was patronizingly designated by our contemporary, and it was always a matter of wonder to us that so little encouragement was offered to him by Englishmen. As time goes on, or perhaps after the editors of the *Review* have visited the World's Fair, there will be an awakening to a realization that, in this country at least, it is the young men who do the best work.

(*Continued from page* 305.)

cuit. That the magneto-motive force, having its origin in the ampere-turns on the armature is inverse and not direct is evident from the fact that when the brushes are rocked forward the poles induced in the armature by the field as at BB^1 in Fig. 4, are always of opposite sign to those produced by the armature currents. Hence these currents circulate in such a direction as to demagnetize the field. It is very difficult to estimate the relative value of those two factors of re action, or perhaps the two phases under which this reaction may be studied, but it is not difficult to devise tests which demonstrate the relative difference of this reaction in the two classes of 24 fields before referred to. For this purpose a third brush, placed slightly in advance of one of the main brushes serves a useful purpose.

Imagine the brushes placed on the line BB^1 in the figure, and the external resistance such that the normal current is flowing through the circuit; and let a voltmeter be connected with one main brush and the third brush, which makes contact with the commutator cylinder one or two sections in advance. If the current is increased by cutting off part of the load what may be expected to occur in the voltage of this supplementary circuit? Will it increase or decrease? That depends entirely upon the condition of the field as to separation. If the total electromotive force of the generator remain constant, then as with a battery, the increased current means increased loss of potential in the armature, and therefore a smaller difference of potential at the brushes; and if smaller at the main brushes it will be smaller between the point of derivation of the supplementary circuit. If the field is magnetized to that extent that it is only slightly sensitive to changes in the current, then an increased current will cut down the potential difference between the brushes for the additional reason that while the influence of the field is not increased that of the armature is. With the field less highly excited, so that the permeability of the iron is not much reduced below its maximum, the dynamo responds to an increase of current with a denser field of force, and a higher electromotive force. The growing current may then produce a greater effect in the field magnet than in the armature. In that case the potential difference both between themain brushes and in the third brush circuit will rise with the current.

Both these conclusions are verified by experiments of the machines whose characteristics are given in Figs. 1 and 2. In the old graume-ring machines, with currents under 10 amperes and with the third brush two sections in advance of the main brush, an increase of current is accompanied by an increase in the voltage both between the two main brushes and in the third brush circuit as well. But with larger currents, approaching 20 amperes, cutting out resistance and increasing the current, decreases both voltages. A point of excitation may be found where no change in the third brush voltage follows a moderate increase or decrease of current. With currents above ten amperes the total voltage increases with the increasing excitation, while the potential difference between the main and third brush decreases. In the other machine the change is invariably an inverse one. I have not tried it with small currents in the main circuit, since the field builds up very rapidly as shown by Fig. 1.

That this decrease in the potential difference between the main and third brush is not entirely or largely due to increased loss of potential, consequent on the circulation of an enlarged current through the armature, is easily demonstrated by experiment. In fact, as already stated, it may be coincident with an increase of voltage at the brushes. A machine of the same type as Fig. 1 was run at varying loads and the voltage in the accessory or third brush circuit was measured both when the current was increased by cutting out resistance and conversely. In every case an increase of current was accompanied by a decrease in the voltage both between the main brushes and the main and third brush as well; while the diminished current was responded to by an increase in voltage in both places. Moreover, both the increase and decrease were too large to be accounted for by loss due to resistance in the armature. I will select only two fair average examples out of many observations. Thus, current 10 amperes; total voltage 240.1; third brush 15. current increased to 11.41 amperes; total voltage 211; third brush 12. Now the resistance of the armature from brush to brush was 4 6 ohms hot, and the third brush was two segments in advance of the main brush Total number of commutator bars, 72. Hence the resistance of the two sections of the armature to half the total current was 0.52 of an ohm. The loss of potential due to an increase of current from 10 to 11.41 amperes or from 5 to 5.7 through either half of the ring, was 0.37 of a volt But the total drop was 3 volts, or 20 per cent. Again with a current falling from 10 to 8 3, the voltage rose from 242.8 to 271.8, and the third brush voltage from 14 to 18. In this case the half current decreased 0.85 of an ampere. The gain in voltage in the third brush circuit alone should have been only 0.44 of a volt if this were the only reason for it. It was actually four volts. The imperfect contact of the third brush rendered exact readings difficult, but the variations were always much in excess of those calculated as above.

With this third brush set very close to the main one, so as to get a difference of about four or five volts between them on a 20 light machine, I have observed that the cutting out of a single lamp, whatever the total load might be, produced a reversal of the third brush current when this circuit contains relatively high resistance; and if the brushes are automatically moved by a regulator which produces a gentle vibratory motion of the brush system back and forth, the third brush current will reverse with every backward oscillation of the brushes. The only interpretation of these facts which seemed to me at the time plausible was that the armature reaction was sufficient to cause the neutral line or neutral part of the field to follow the brushes quite closely in their motion about the commutator to maintain a normal current; and this explanation I gave to my class on dynamo machinery and maintained in a semi public way. But further experiments, directed to the exploring of the commutator for the purpose of ascertaining the relative potentials of the various parts, have convinced me that this explanation is not the correct one.

The method consisted in attaching to the brush-holders a circular frame of insulating fibre, with slots cut every ten degrees in its periphery by a milling machine, and employing these slots to hold in succession a third brush.

The potential difference between one of the main brushes and this movable third brush was measured entirely round the commutator with different loads, and always with 10 amperes through the circuit of the machine. The first position of the brush was such that the potential difference was zero. The several values with no external load, with a resistance equivalent to three lamps, and finally equivalent to nine lamps, I have platted round the circle in Fig. 5. The position of the brushes 0° and 180°, with the machine nearly short-circuited and with the brushes rocked forward fully 65° x 70° beyond their positions for maximum load, you will see that the potential ran up to a maximum positive at nearly 80° from the positive brush, and then ran down, so as to be identical with that of the same brush at about 128°. So also a negative maximum was attained at 260°. The difference of potential between these two positive and negative maxima was 644 volts. The same distance was found when two extra brushes were placed at these two highest points. The line joining these points, usually called the theoretical neutral line, lies forward of the medial line between the magnet poles and is distant about 20° from the leading pole tip. All the electromotive force generated in the coils from 0° to nearly 80° is therefore counter electromotive force. The same is true of the opposite side of the armature. The points *AA* in Fig. 6 correspond to the two maxima described. At these points the electromotive force generated changes sign and they must therefore be on the neutral line. *BB* is the line of the brushes.

With three lamps in circuit, or their equivalent in iron wire resistance, the brushes were rotated backward 15° and the points of the highest and lowest potential, as compared with the main brush, were 65° and 245°, being respectively about 168 and 456 volts. With the highest load carried, the brushes were rocked back 50° further and the two main brushes were then very nearly at the maximum and minimum points.

If now we study Fig. 5 we shall find that the region of the commutator on either side of a brush, or the armature coils in these positions, is a relatively weak field, the angular distance through which the potential rises to a maximum being nearly double that required to bring it down again to the level of the main brush. Thus, in the outer curve the maximum is at about 78° and it crosses the circle again at 128°. So the next one attains its highest positive value in the vicinity of 65° and crosses the zero level again at 95°. Similar differences are exhibited on the opposite side of the circle of reference. In Fig. 6 the regions marked *W* are relatively weak, as compared with those marked *S*. The places of maximum activity are near the polar boundaries at *E*. If the several maxima be laid off from the position of the brushes as zero, it will be found that they all fall, as nearly as can be determined, at the same place. This fact is brought out more clearly by plotting the potential differences as ordinates from a straight line as in Fig. 7. From these curves it is evident that the maximum positive and negative ordinates of the first curve, taken with no load, fall at about 78° and 260° respectively, corresponding in position, as nearly as can be determined, at the same parts of the field as those of the other curves. I find no evidence in these curves that the rocking forward of the brushes to control the current, with diminishing external resistance, causes the theoretical neutral line to move to any considerable extent.

I do find, however, that the poles of the armature, which are always at the brushes, exercise a marked influence on the field, wherever they are. It is easy to see that the curves are all flattened out in the vicinity of the brushes, as at $B^1B^1B^1$. This flattened region extends a good deal beyond the limits of the contact of the brushes with the commutator cylinder, though the lapping over of the brushes doubtless contributes to this result. If we imagine a bar magnet placed in a powerful and approximately uniform field of force, or stream of lines of magnetic force, with its own field opposing that of the field in which it is placed, it is easy to foresee the effect it will have in reflecting and scattering the lines of the main field, so long as its own magnetism is not reversed,—so long as it retains its own autonomy or system of governing forces within another system. Such is the influence of the armature magnetism upon the field of generator. It not only weakens that field by introducing a counter M. M. F., but it weakens the field locally, by a deformation and scattering of the lines belonging to the field of the main magnet. Hence the flattening of the curves at the brushes, and the uniformity of field secured in their vicinity wherever they may be located

Before leaving the curves of Figs. 5 and 7, it may be of interest to describe an additional experiment suggested by these curves. If two extra brushes are provided and made to bear upon the commutator at the highest and lowest points of the curves in Fig. 5 and Fig. 7, then substantially the same current will flow through this auxiliary circuit, whatever the load in the main circuit. To test this, two extra brushes were made to bear at points 80° and 260° distant from the main positive brush with nothing in the main circuit except the electrodynamometer. The conditions were those of the outer curve of Fig. 5. The circuit of the two extra brushes was then closed through a resistance of 180 ohms, and it was found that a current of 3 3 amperes was maintained through it. At the same time there was no increase in sparking at the main brushes, and the potential difference between them rose from 124 to 162 volts, the current increasing from 10 to 12.6 amperes. The same experiment was tried with the conditions necessary to secure the second curve, the extra brushes being fixed at 60° and 240° respectively, from the main brush. The current in the auxiliary circuit was 3 amperes, and that of the main circuit increased, but to a smaller extent than before. The contact of the small brushes with the commutator was not so good as it should have been.

The conditions requisite to maintain a sparkless commutator when the lead of the brushes is varied with a varying load, so as to maintain the normal working current, seem to me now quite clear. A fairly uniform field, with pole pieces not too heavy, and an armature magnetically powerful relative to the field, will accomplish the result when the field magnet is magnetized to such an extent that it is no longer greatly sensitive to moderate changes in the current.

The really fundamental condition is not the one generally or universally laid down in the books, viz., that the brushes shall be only slightly in advance of the theoretical neutral line, or the line across which the impressed electromotive force in each coil changes sign in passing. The brushes may be at any distance from the neutral line. The condition is simply that the counter electromotive force generated by any coil as it passes under the brush shall be sufficient to offset the electromotive force of self induction, due to a reversal of the current in a coil in passing from one side of the brush to the other, and shall in addition cause the newly directed current to grow to its normal value as the segment leaves the brush. This means that the field of force at the brushes shall be practically constant. This practical constancy is maintained in every well constructed constant current generator, with closed coil armature, by the magnetic influence or reaction of the armature itself, in flattening out and weakening the field at its poles. No special proportioning is necessary to accomplish this result since the old Langley machine, to which I have already alluded, shows the same property. It will govern from full load to no load, without any marked sparking at the brushes in any position.

Individual machines of any type will have their own idiosyncrasies. The smaller patterns will sometimes spark more than the larger ones. Some will spark a little more at full load, and some more at no load, and very many do not spark at all when the brushes are in good order and properly set. With all such machines the diameter of minimum sparking is practically the diameter of commutation for the constant normal current. The brushes cannot be placed near the theoretical neutral line, a little in advance of the needle points between the poles, except at full load, for otherwise destructive sparking will ensue. So also if the field is separately excited, and the brushes are rocked forward on open circuit, furious sparking will take place. The coils are short-circuited then in an active part of the field, with no self-induction to overcome, and no armature poles to plow through the field and deform it, scattering the lines of force as they move forward.

The change of voltage in the third brush circuit, whenever the main current varies from its normal value, suggests the practicability of utilizing this relation for the purpose of securing automatic regulation of the current. This method I have tried with satisfactory success. The third brush circuit contained an electro magnet as a responsive device, and this served to bring into action either an electro magnetic motor or mechanical motor mechanism for rotating the brush holder. With the third brush two segments in advance of the main brush, or about 75°, the following table of results was obtained, as lamps were cut in and out.

Lamps.	Amperes.	Lamps.	Amperes.	Lamps	Amperes.
16	10	7	10.2	3	10
15	9.9	6	10.1	5	10.1
14	10	5	10	7	10 5
13	10.2	4	9.9	9	10.5
12	10.3	3	9 6	11	10.3
11	10.4	2	9 8	13	10 2
10	10.3	1	9.3	14	10
9	10.2			10	10
8	10.1				

There was no sparking during the whole motion of the brushes. The practical constancy of current secured demonstrates the constancy of the field in the vicinity of the brush when the main current is at its normal value. This uniformity near the polar surfaces of the armature, in whatever part of the field these poles may be, demonstrates that the armature reaction in constant current generators is of enormous importance.

If this third brush circuit is of such low resistance that the main current divides so that a material portion of perhaps 30 or 40 per cent. passes off through the third brush, then an increase of the total current through the armature is accompanied by an increased current from the third brush, since this current is merely a branch of the main current derived from the generator.

American Institute of Electrical Engineers.

The annual and general meetings of the American Institute of Electrical Engineers was held in New York, May 19, 20 and 21. The following named members were present: Alexander S Brown, Boonton, N. J.; Dr. Louis Bell, Ralph W. Pope, H. A. Foster, New York City; A. J. Newell, Holyoke, Mass.; Thos. D. Lockwood, Boston, Mass.; H. C. Townsend, New York City; P. B. Delaney, South Orange, N. J.; Wm. Maver, Jr., T. C. Martin, Franklin L. Pope, Dr. S. S. Wheeler, W. A. Giles, James Hamblet, J. C. Bennett, New York City; Prof. Wm. A. Anthony, Manchester, Conn.; Geo. B. Prescott, Jr., J. P. Wintringham, Edward P. Thompson, Edward Caldwell, Wm. A. Rosenbaum, Dr. Louis H. Laudy, New York City; Dr. Wm. E. Geyer, Hoboken, N. J.; John W. Howell, Newark, N. J.; E T. Birdsall, C. O. Mailloux, Prof. Francis B. Crocker, W. G. Whitmore, E. M. Rosenberg, Johannes H. Curtz, Hoboken, N. J; Francis R. Upton, Newark, N. J.; Wilfrid H. Fleming, Herbert Laws Webb, Dr. Cary T. Hutchinson, Gilbert Wilkes, New York City; G. F. Atwood, Orange, N. J; Joseph Wetzler, Geo. M Phelps, New York City; Dr. F. A. C. Perrine, Trenton, N. J.; Robert T. Lozier, J. B. Taltavall, W. T. Herout, C. L Cornell, New York City; S. D. Mott, Passaic, N. J; Prof. F. R. Jones, Knoxville, Tenn.; Wm, J. Hammer, H. Ward Leonard, New York City; Wm. Elmer, Jr., Princeton, N. J.; Frank C. Per-

kins, Ithaca. N. Y.; John S Cobb, Philip V. R. Van Wyck, Jr., E. V. Baillard, New York City; W. G. Anthony, Newark, N. J.; Geo. C. Grower, Ansonia, Conn ; James S. Alden, Passaic, N. J.; Frederick Bedell, Montclair, N. J.; A. Langstaff Johnston, Richmond, Va.; Dr. Edward L. Nichols, Ithaca, N. Y.; J. Martin, Newark, N. J ; H. G Fiske, Chas. J. Bogue, W. J. Johnston, Fred A. Bowman, New York City; M E. Thompson, Cornell University; Chas. S. Bradley, Avon, N. Y.; E. M. Hewlett, New York City; John D. Wright, Newark, N. J.; Prof. Edwin H. Hall, Cambridge, Mass.; Dr. P. H. Vander Weyde, Brooklyn. N. Y.; Carl Hering, Philadelphia, Pa.; Herman S Hering, Philadelphia, Pa.; M. B. Leonard, Richmond, Va.; P. H. Alexander, Harold Binney, Dr. Otto A. Moses, Gano S. Dunn, New York City; E. C. Boynton, Brooklyn, N. Y.; C. Reginald Van Trump, Wilmington, Del.; Osborn P. Loomis, Brooklyn, N. Y.; J. N. Johnson, M. C. Sullivan, New York City; R. Varley, Jr., Passaic, N. J.; H. N. Sweet, Boston, Mass.; F. H. Lalder, London, England; H. A. Ockershausen, Geo H. Stockbridge, Geo. W. Tuttle, E. W. Stevenson, New York City; John Waring, Manchester, Conn.; Edward Weston. Newark, N. J.; Th Bute, Magdeburg. Germany; A. Von Bonnies, Hanover, Germany; Oscar W. Petri, Washington, D. C.; C. Billberg, Philadelphia, Pa.; Holbrook Cushman. T. R. Taltavall, Geo. W. Walker, New York City; Douglass Burnett, W. L. Bliss. Brooklyn, N. Y.; W. B. Tobey, Pittsfield, Mass ; H. Cochran, Brooklyn, N. Y.; E. A. Sperry, Chicago, Ill.; Fred. Saxelby, Harrison, N. J.; Stephen L. Coles, I. W. Henry, E. E. Bartlett, New York City; E. W. Rice, Jr., Lynn, Mass.; F. E. Idell, D. E Hervey, New York City; Dr. Leonard Waldo, Bridgeport, Conn.; W. F. D. Crane, East Orange, N. J.; Prof. Elihu Thomson, Swampscott, Mass.; C H. White, Lockport, N. Y.; Dr. W. H. Wahl, Philadelphia, Pa.; Oberlin Smith, Bridgeton, N. J.; William Stanley, Jr., Pittsfield, Mass.; Fred. Reckenzaun, West Hoboken. N. J.; J. G. White, Nikola Tesla, F. W. Jones, Frank J. Sprague, Chas. W. Price, New York City; T. A. Uehling, Boonton, N. J.; Allen R. Foote, Washington, D C ; C. O Balor, Jr., Edward A. Colby, Newark, N. J.; H. V. Parsell, Jr , New York City; Prof. George Forbes, London, England.

The secretary's report shows that ten monthly meetings were held during the year, at which twenty-five papers were presented. The total membership is 541, and the financial affairs of the association are in an excellent condition.

The following officers were elected: President, Alexander Graham Bell, Washington, D C.; vice presidents, Thomas D. Lockwood, Boston, Mass.; Carl Hering, Philadelphia, Pa.; Oscar T. Crosby, Boston, Mass.; W. J. Hammer, New York City; managers, Louis Bell, Herbert Laws Webb, Prof. A. G. Compton, James Hamblet; secretary, Ralph W. Pope; treasurer, George M. Phelps.

The Perfection of Stationary Electric Motors.[1]

By Francis B. Crocker.

A study of the history of the electric motor shows us that from the very beginning to the present time there has been a great tendency toward complicated, fanciful and unpractical designs, including outlandish forms of field magnets and unnecessary multiplicity of field cores and coils. In most cases also the mechanical construction has been very bad, the shaft being too small, the bearings being weakly supported, and the general finish and workmanship being rough, and not up to the standard of first-class machinery. From the electrical standpoint the insulation has been very poor and shares equally with imperfect mechanical construction the responsibility for the

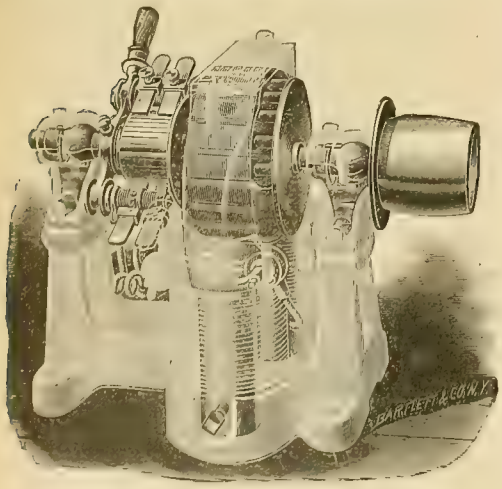

FIG 2.

numerous troubles and failures which have occurred with electric motors. The magnetic circuit of motors has also been designed in a way that indicates entire ignorance of the laws governing the production of a strong magnetic field. In all these respects the electric motor has been worse than the contemporaneous dynamo electric machine, the reason being, I think, that the men who have studied and designed the dynamo have been more competent than those who have turned their attention to the electric motor, electric power being comparatively a more recent development of electricity than electric lighting. There have been, of course, notable exceptions to the general badness of motor design and construction, but in the case of all these exceptions, which are few, I think it will be found that the superiority of the motor in each particular case was directly due to the presence of an electrical engineer of recognized ability.

Electric motors are used for three different classes of work. First, transmission of power over considerable distances, for example from Niagara Falls to Buffalo; second, distribution of power, for example in a district of a city from a central station, and third electric railway work.

The first of these classes of work usually requires large motors, over 50 or 100 horse power; the second requires comparatively small motors, ranging between 1-8 and 10 horse power; the third requires motors from 20 to 100 horse power and a peculiar construction adapted to their special purpose. I purpose to consider in this paper motors of the second class for distribution of power especially.

It has long been my opinion that the proper way to design a good electric motor is to consider very carefully and systematically each part, first by itself, and then with reference to the other parts, and thus collect and build up the elements which are best not only in themselves but also in combination with each other, so that finally, by putting and fitting these parts together with the best possible workmanship, the best result will certainly be obtained. The correctness of this procedure is so self-evident that it seems hardly necessary to uphold it, but everyone familiar with electric designing of all kinds will admit that the usual process has been to invent some peculiar form of armature or field and then attempt to fit the rest of the machine to this particular part, producing all sorts of anomalous and awkward constructions. It will also be admitted that experience has taught us that the simpler and less extraordinary forms of machine have usually been more successful. In fact I believe there is no kind of electrical apparatus in which sensationalism in design has been successful, except perhaps in arc light dynamos. Let us now take up the various parts of the electric motor, and consider each as a simple problem in designing.

Base. This should be a solid iron casting, flat and simple in form, and resting directly and squarely upon the base frame or floor, which latter should preferably be of wood to secure insulation. The base should be heavy to bring the center of gravity low; in fact, this is the only part of the machine where weight is not only not objectionable, but very beneficial, and since it is merely of plain cast iron the extra cost is insignificant. A heavy base does more than anything else to give great stability and strength to the whole machine, and is highly desirable in a stationary motor. The bearings should be directly and rigidly mounted upon this base, a fact that is often disregarded.

Field Magnets. The field magnet should be *bipolar* except in the larger machines, above 10 horse power, on account of the great complication caused by the increased number of armature sections, commutator bars, field coils, etc., necessary in multipolar machines, and the narrowness of the neutral or non sparking space on their commutators; for example, multiple brushes or cross-connected armatures are particularly objectionable in small machines. The field should also be a single magnetic circuit rather than the consequent pole type, because the former is more economical in wire and current required. For example, one turn of wire around a 7 in. core is equivalent to the two turns of wire around two 5 in. cores, the cross-section of one 7 in. core being nearly equal to that of two 5 in. cores, whereas the length of wire is only 70 per cent. as much with the single core. In other words, a single circuit requires only 70 per cent. of the weight of wire and 70 per cent. of the energy of magnetization that is required by a double magnetic circuit. A triple magnetic circuit or quadruple magnetic circuit—that is, three or four cores magnetically in multiple arc—are still more objectionable, requiring about twice as much wire as a single core of the same total cross section.

The field magnet may be arranged with respect to the base described above in three general ways: First, the pole pieces may be set upon the base (Edison type); this form requires non-magnetic material, usually zinc plate, to be interposed to prevent magnetic short circuiting through the iron of the base; even with a zinc plate Hopkinson found 10.3 per cent. magnetic leakage through the face of the Edison Hopkinson dynamo.

Second, the iron base may form one of the pole pieces (Manchester type). This is also objectionable on account of the greatly increased magnetic leakage, which is practically proportional to the surface exposed to the air, and the extension of the base necessary for the bearings, etc., greatly increases this surface, and also allows the magnetism to leak up into the shaft, pulley, etc., causing various troubles. This form has the further objection that it is of the consequent pole type, the disadvantage of which I have just pointed out.

Third, the iron base may form the yoke of the field magnet with the cores and pole pieces extending upward (Kapp or "inverted horseshoe" type). This plan has neither the leakage nor other faults of the other forms and possesses the great advantage that the pole pieces are removed as far as possible from the base, bearings, etc , thereby avoiding magnetic leakage; and the base being purposely made heavy for stability and strength, as already stated, is therefore exactly suited to being used as the yoke, thus performing two functions to the best advantage. There is, moreover, no objection to using a cast-iron base as the yoke to complete the magnetic circuit, since the heavy base I have insisted upon is of large cross-section and therefore of ample magnetic permeance and the increased size of the iron yoke does not aggravate the magnetic leakage because it is magnetically neutral. The field cores should be of wrought-iron because the field wire surrounds them, and the use of cast-iron, which is of low permeability, would require a core of almost twice the cross-section, and therefore a much greater length of wire to obtain the necessary magnetizing force. With the smaller wrought cores the magnetic leakage would also be less. The pole pieces should also be wrought iron to reduce their size, and therefore their magnetic leakage, they being at the highest magnetic potential of any part of the machine. In regard to magnetic leakage, I would call attention to the fact that it is objectionable not only on account of wasting lines of force, but because it affects electrical instruments, watches, etc., in a very troublesome manner.

The field magnet cores and pole pieces being preferably of wrought-iron, the question of uniting them to the base and to each other next arises. Since any considerable fitting or working of wrought-iron is difficult and costly, the best solution of this problem certainly seems to be to forge (i. e., drop-forge) the core and pole piece in one piece. This also permits the bore or space for the armature to be perfectly formed at the same time. In connecting these cores to the cast-iron base, it is practically essential to set them into it in order to get sufficient contact and strength since the ordinary butt joint between wrought and cast-iron limits the magnetic conductivity almost as much as if cast iron were used throughout. This

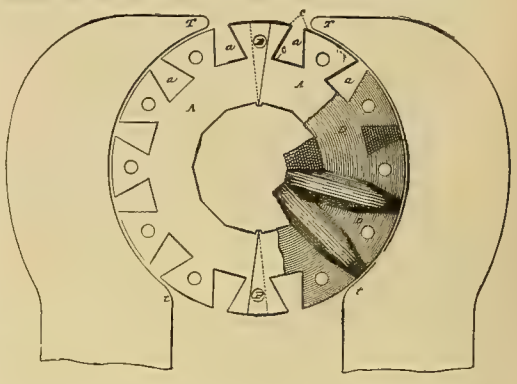

FIG. 1.

method of putting the magnetic circuit together reduces the work of fitting wrought iron to a minimum, which work is the only objection to the use of wrought iron. The supposition that cast iron is cheaper than wrought for magnets is a fallacy, as its permeability is as much below that of wrought iron as is its price, both being about one-half.

Field Coils. These should of course be perfectly insulated, a result which can be accomplished with certainty by winding them on a solid spool of material which is fire and water proof and highly insulating. These spools should never be made of material that softens by accidental heating of the wire, as this would allow the wire to cut through and make a "ground" on the core, which is just what the spool should prevent. I have tested spools of this kind which cut like cheese when a wire heated by a current was applied to them, this being a very effective method of testing this point.

Armature. In regard to the choice between the ring and drum forms of armature, the advantage of the drum is that it is easy to support mechanically, but it is difficult to wind, as the wire is apt to slip out of place and leap out on the ends of the drum, and more serious than anything else is the fact that the wires of a great difference of potential cross or approach very near each other, causing great liability to short circuit. The ring armature is somewhat hard to support mechanically, but the winding does not tend to slip out of place or pile out on the ends, and wires of the greatest difference of potential come at the greatest distance apart, that is, on opposite sides of the armature. This is of the utmost importance in the case of high voltage machines. In the case of large ring armatures or those with few turns of wire, there is little trouble in winding; but in the case of the small ring armatures or where a great number of turns of wire are used, the ring should be split in halves to facilitate winding and put together afterward when wound.

Toothed Armature. The armature should have teeth or projections upon it in order to secure the following advantages:

First, to reduce the reluctance of the magnetic circuit and the weight of wire and energy of current required to magnetize it.

Second, to hold the wires in place and prevent them slipping tangentially on the core, the tendency to which is much greater than is usually supposed, there being a tangential pull of about 160 lbs. on the wires of a 10 horse power armature 8 in. diameter, running at 1,000 revolutions per minute.

Third, the teeth protect the wires from mechanical injury since any blow or pressure which the armature receives comes upon them instead of upon the armature wire, which is very easily injured, and the machine thereby ruined.

Trapezoidal Tooth Armature. A certain form of teeth I have found to possess decided advantages over the ordinary parallel sided teeth and slots heretofore used. This form of teeth is considerably wider at the top than at the bottom which, of course, makes between the teeth a slot which is wider at the bottom than at the top. This shape of tooth and slot has the following additional advantages over those of the ordinary toothed armature—first, the wire is more completely held in place, being held against centrifugal force as well as against tangential force; second, the wire is also more perfectly protected mechanically, since it is almost entirely surrounded by iron; third, the armature presents an almost unbroken magnetic surface to the pole pieces, thereby reducing to a minimum the reluctance of the air-spaces in the magnetic circuit and the magnetic leakage, and avoiding Foucault

[1] Read at the general meeting of the American Institute of Electrical Engineers, New York, May 29, 1891.

currents and loss of energy in the pole pieces. This trapezoidal form of slots and teeth can be still further taken advantage of by giving the former a shape which exactly agrees with the form of a section of winding on the inside of the ring, as shown in Fig. 1, the interior spaces for winding being divided into the necessary number of sections by radial lines. This exact conformity between the inside and outside of the winding makes a perfectly symmetrical coil, with no tendency for a single turn of the wires to cross at any point, and the coils on the inside occupy the whole space with the greatest possible advantage, whereas ordinarily the interior of the ring is liable to be overcrowded with wires. The trapezoidal form of slot is particularly economical as regards winding, for the reason that there are a greater number of turns in the inner layers which are shorter, and fewer turns in the outer layers, which are longer, as shown in Fig 1. The armature teeth make it easy to support the ring perfectly, since the bolts for carrying it may pass through the teeth without interfering with the winding. These bolts being held at the two ends by brass spiders or supports, make a very strong and convenient means of mounting the ring upon the shaft, and thereby overcome the objection to the ring armature. In the trapezoidal form of teeth which I have described there is even more space than in the ordinary form of teeth for the boltholes, and in this way larger bolts and stronger support can be obtained. The perfect insulation of the armature core is of the utmost importance, The best material and the most complete covering should be used, and the greatest possible care should be exercised to avoid short-circuits, "grounds" or broken wires.

Efficiency. This should, of course, be as high as possible, and is made a maximum by reducing all elements of loss as far as possible. These losses are current to magnetize field, loss due to armature resistance, friction, resistance of air, Foucault currents and hysteresis. It has always seemed to me that the efficiency is necessarily high if the machine is properly constructed, and if the efficiency is low it must be due to some loss, which is more objectionable in itself than because it involves a reduction in efficiency, because this loss must necessarily manifest itself in the form of heat in some part of the machine, for example, the field-coils, armature or bearings. This heat is liable to do more harm by its direct effect upon the heated parts, causing a burn-out or charring of insulation in the winding or cutting of the bearings, and any effect of this kind is much more serious than the inefficiency from which it results. The same fact can be expressed in another way by stating that if a machine can be run for one or two hours at full load without any part becoming overheated, the efficiency of that machine must be high, unless the machine is very large and heavy for its power, in which case the surface for radiation and conduction would be great. This fact is more absolute than any efficiency test can possibly be and very small losses which an efficiency test might not disclose would be indicated by local heating, if for example, the effects are allowed to accumulate for a half hour of steady running.

I can best illustrate the foregoing statements and recommendations by describing the set of electric motors designed by Dr. S. S. Wheeler and myself. They were developed by precisely the same process of reasoning as that given in this paper.

The fields are put together according to a method which consists in drop-forging the core and pole piece in one piece and exactly to shape; then mounting it upon a holder in such a way that the ends of the cores are trimmed with exact reference to the armature bore, and holes being bored in the cast-iron base the proper distance apart, the cores are set into it to the depth they are trimmed off and produce a space for the armature exactly suited to it. This is much simpler than fitting the field magnets and base together and then boring out the armature space, the operation of boring being a slow one and requiring heavy machinery. The field cores set into the base are shown in Fig. 2.

The magnetic circuit produced by this method is excellent. In the first place there are only two joints and these are of very large surface and fit very perfectly, being where the cores fit into the base. The surface of contact of each of these joints is about four times the cross-section of the core and therefore about twice the cross-section of the equivalent cast-iron. The core and pole piece being made integral, avoids any joint between them as well as any necessity for expensive work in fitting them together. In fact, the only machine work required in fitting the fields to the base is simply trimming off superficially the ends of the cores and reaming the two holes in the cast-iron base, these holes being cored out in the casting,

The armature is made with trapezoidal teeth, as shown in Fig. 1, and having an almost unbroken surface of large extent exposed to the pole piece with a clearance of only one-sixteenth of an inch; the magnetic reluctance of the air gap is reduced to the lowest possible value. This exceedingly low reluctance of the magnetic circuit reduces the amount of wire required to excite the field to such an extent that only very short field coils and cores are needed, being only about one-third or one-quarter of the length required with armatures having no teeth and the ordinary air gaps in the magnetic circuit. This small quantity of wire on the field, amounts to only twelve pounds in a 3-horse power machine and sixteen pounds in a 5 horse power machine. It has not only the advantage in economy of wire, but also makes the machine very efficient as regards current consumed in the field, being less than two per cent. in the two machines referred to. The reduction of field wire and length of coil required, is particularly important in bringing the shaft of the machine down sufficiently near the floor to give the machine stability and steadiness in running. In fact, the only objection to the "inverted horseshoe" type of field is that heretofore it has involved the use of long field coils which brought the shaft, almost twice as high above the base as it is desirable to have it, giving a top-heavy and unsteady result. In the type of motor described, the shaft center is less than a foot from the floor in the 3-horse power size, and is just about the proper height to make the pulley, belt, gear wheels or other mechanical connections clear to the floor and have sufficient room to work properly. This complete overcoming of the heretofore serious objection to the "inverted horseshoe" type makes a thoroughly satisfactory field construction without any of the disadvantages of all the other forms.

The actual results obtained from these motors, which of course is the most important and conclusive thing to know, are given in the following table, and include the various mechanical, electrical and magnetic constants of the machine. All the sizes of this type of motor are made almost exactly the same in design, proportions and construction and differ only in scale, hence a description of one machine applies to all, with proper allowance for difference in size.

Data of 3-horse power Crocker-Wheeler motor, designed for 115 volt constant potential circuit:

Total weight	350	lbs.
Weight of field wire (No. 24, a. w. g.)	12	lbs.
Weight of armature wire (No. 13, a. w. g.)	11	lbs.
Resistance of field	310	ohms
Resistance of armature	.4	ohm
E. M. F of circuit	115	volts
Total current at full load	24.3	amps.
Current used to excite field	.37	amp.
Percentage of current used in field	015	
Total current required to run free	1.9	amp.
Percentage of total energy to run free	.08	
Commercial efficiency	.80	
Armature speed	975	r.p.m.
Total magnetic leakage or waste lines of force	.17	
Magnetic efficiency $\frac{\text{Lines through armature}}{\text{Total lines of force}}$	.83	

The above data for the most part explain themselves, but I desire to call attention to several particularly interesting points.

The weight of field wire is extremely small, being only 12 lbs., compared with about 40 to 50 lbs. in most machines of this size. I actually found the weight of field wire to be 60 lbs. in a type of motor of equal capacity, which is claimed to have the best possible magnetic circuit.

The table also shows the current used in field to be only 1½ per cent., which is remarkably low for machines of this size, which usually require about 5 per cent.

The current required to run free, at full speed, is also exceptionally small, being only 8 per cent.

The commercial efficiency is high for a motor of this size, particularly when the very low speed is considered, because an increased number of turns of wire on the armature is required to make up for the reduced speed, and this augments the armature resistance, and causes loss. The efficiency does not vary more than about 1 per cent. from half to full load, which is quite an interesting fact

The speed, it will be noticed, is very low for this size of machine.

The magnetic leakage or loss of lines of force is extraordinarily small, amounting to only 17 per cent., and giving what may be properly called a magnetic efficiency of 83 per cent.

This small magnetic leakage is due to the facts already stated in this paper in regard to the design of the field magnets. In this connection it should be remembered that Hopkinson in his classical investigations of the magnetic circuit found that there was 24.24 per cent. magnetic leakage in the Edison-Hopkinson machine. I may also state that A. S. Ives, student in electrical engineering at Columbia College, found 40 per cent. leakage in a well known dynamo (400 light) of a recent, though not the very latest type.

In conclusion, I would state that it is obviously impossible in one paper of reasonable length, to completely treat the subject of motor design, but I have attempted to bring out the most important points, and lay before the Institute the best results of considerable study and experimental work on the part of Dr. Wheeler and myself in the direction of improving and perfecting the design and construction of stationary electric motors.

There is one single merit in the paper to which I lay claim, and that is the fact that the ideas I have advanced are embodied in a large number of actual working machines which are open to any one for examination and criticism, whereas the design of electric motors is usually given on paper only, and is therefore very intangible, and correspondingly safe so far as the author is concerned.

Electric Meters.[1]

By Geo. W. Walker.

The time has come for the central station companies to realize that they must supply the electric current in a more thoroughly commercial manner, that is, it must be sold as other commodities are sold, by measure, weight, or its equivalent.

As gas was the follower of the tallow dip, so is electricity the successor to gas, and one of the legacies inherited by us is the much abused and anathematized gas meter. The peculiarities of this somewhat venerable object are numerous, sometimes amusing, many times annoying and expensive, as our personal experience will prove. It has by comparison, caused the ever suspecting public to look with suspicion upon the electric meter, even though they see the wheels go around.

A perusal of the United States patent office reports show that up to date about 185 patents have been granted on electric meters alone. The first patent granted by our government on electric meters was No. 132,569, dated Oct. 29, 1872, and issued to S. Gardiner, Jr., of New York city.

No further patents were issued until the year 1878, when one was granted to W. E. Sawyer of New York City. The same month, Nov. 26, a patent was issued to Jim Billings Fuller of Brooklyn, N. Y., on what was perhaps the first alternating meter invented.

The patents granted to Sawyer and Fuller were the only ones issued in 1878. One patent was granted in 1879; three in 1880; seven in 1881; seven in 1882; eight in 1883; nine in 1884; five in 1885; twelve in 1886; thirteen in 1887; twenty-two in 1888; thirty-six in 1889, and about sixty during the year 1890 and up to the present time. A careful examination of the 185 patents issued reveals many ingenious devices for the measurement of the electric current, but in most cases the expense of manufacture, the likelihood to derangement and the cost of operation, kept these meters out of the race, from a practical standpoint.

The patent office reports show numerous devices for securing the record of the ammeter needle on a moving strip of paper by the use of a syphon pen or pencil. In all such cases, however, the element of friction is so apparent as to make their use prohibitive.

The patent granted to W. C. Patterson, No. 333,770, issued January 5, 1886, and another to myself, No. 406,678, dated July 9, 1889, are the only ones which cover the use of paper which is sensitive to light in combination with electrical measuring devices.

[1] Abstract of paper read before the American Institute of Electrical Engineers May 21, 1891.

Considerations Which Should Govern the Selection of a Rapid Transit System.[1]

By Frank J. Sprague.

It has been but a short time since the legislature of New York, in response to public demands as voiced by the press, in petitions, and through the personal efforts of the representatives of this city, enacted a rapid transit law to create a board of commissioners with large powers for the purpose of determining rapid transit routes for this city.

There are two classes of people who are concerned in the commissioners' final decision, the public and the capitalists. In order to satisfy, as far as possible, the demands of both, some of which are common, it is well to examine them separately.

To accommodate the public it is necessary to:

First. Supply demands by following as nearly as possible the most important existing arteries of travel. An express train on the banks of the Hudson would be of little use to Broadway.

Second. Provide for those future lines of traffic which, other things being equal, will most naturally be formed.

Third. Make the most numerous and convenient connections for existing and projected local and suburban transit lines in directions other than those followed by the main system.

Fourth. Interfere least with changes in present buildings, or the erection of future ones. In no city in the world is this change more pronounced or continuous.

Fifth. Cause the least disturbance to, or weakness of, foundations, present or future, and unnecessary displacement of service pipes, whether steam, gas, electric, air or sewer.

Sixth. Avoid disfigurement of streets and unnecessary appropriation of them.

Seventh. Inflict the least damage to property, either during construction or afterward in operation.

Eighth. Provide the highest express and way speeds, each on independent tracks.

Ninth. Attain this last with the least liability of derailment or other accident.

Tenth. Provide the easiest access to stations, taking of all trains from one station, transfer from way to express trains and vice versa, from up to down trains, or to cross town trains or other intersecting lines.

Eleventh. Finally, it must be built as quickly as possible, and should possess great flexibility.

To attract capital the system

First. Should afford a reasonable and certain return on the money invested in the near, and a greater return in the remote, future. To do this the road must attract passengers, which it will do by following the main arteries of travel, and by affording increased speed, with increased comfort and safety.

Second. Must be built economically, and as cheaply as possible consistent with sound plans for future growth.

Third. The cost should be calculable with reasonable accuracy. This cost is comprised in a number of elements as follows:

Preparation of way, such as tearing down buildings, digging up streets, moving pipe systems, altering sewers, sinking of shafts, etc.

Actual construction, such as building of viaducts, erecting superstructures, driving tunnels, laying road-beds.

Temporary damage to and blocking of public and private business and travel during construction.

Permanent damage to property, whether caused by proximity of road, noise, dirt or vibration, weakening of foundations or interference with future buildings.

Building space taken up, either by the roadway, moving trains or necessary clearance above them.

Equipment of rolling stock, less with steam, greater with electricity.

Fourth. Should be such a construction as to make additional tracks possible, if future demands should warrant it, whether such tracks be parallel to or intersect with the main system.

Fifth. The process of construction should be hampered as little as possible by injunctions or legal complications of any kind.

Sixth. The place of construction should be such as can be most readily begun, most rapidly carried forward, and most quickly enable the road to become a dividend earner.

Seventh. The franchise granted should be secure from unjust restriction and future interference.

Eighth. The raising of capital should not be made difficult by the granting of privileges for extension to existing

[1] Abstract of paper read before the American Institute of Electrical Engineers, May 21, 1891.

corporations of such character as to make their competition in the same field. An extension of the "elevated" up the boulevard would have its influence on any other system proposed for the same route.

If there were no other way, nor any better one, to obtain rapid transit in this city than by the system set forth by the Manhattan company, I should say by all means let the system be thus extended, but every one within reach of my voice knows that other methods of construction can be adopted which are free from a large number of the objections which are inherent to the elevated railway system, and knowing this, we are justified in doing what lies in our power to aid in the adoption of such other methods.

In order that the commission may have the greatest latitude of judgment, the determination of motor power should

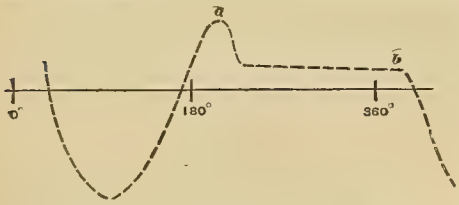

FIG. 1. A PHOTOGRAPHIC STUDY OF THE ELECTRIC ARC.

precede that of construction, and the method of construction that of route.

Two systems of motive power only are under consideration, steam and electricity, the former an agent whose advantages and disadvantages are well known, the latter a newer application of force, one in which the layman is not so well versed, but one whose advantages and possibilities are well understood, and most thoroughly relied upon, by those who have made it their particular study.

The vital importance of letting the determination of motive power precede that of construction and route will be clearly illustrated by noting the limitations upon construction. There are five general plans which have been proposed.

(a) An elevated steel structure, similar in character to the Manhattan system, and occupying the public streets.

(b) The viaduct masonry construction similar to some of the London sections of English trunk line systems, the viaduct road of Berlin, or the Broad Street section of the Pennsylvania railroad in Philadelphia, to run through the middle of building blocks, and to span the streets with steel arches.

(c) A shallow tunnel made by excavating the streets, removing or diverting the existing system of pipe services of all kinds, running the tracks in one or two tiers, either superposed, or in different vertical planes, the street to be floored over with a steel girder structure. The inclosed track would be something like the Fourth Avenue Harlem road tunnel, except that it would be entirely inclosed.

(d) An iron tubular closed tunnel construction, the tubes running at a depth of from twenty to forty feet below the surface, and built something like the North River tunnel, but individualized like the Suburban and South London road constructed in London by the Greathead interests, and opened for regular service last November.

It is important to know what are the objections raised against the use of electricity. About the only one made public is that it has not yet been used on as large a scale as would be required in the proposed system. This reason seems ultra conservatism, and it is to be regretted that on a subject of such vital importance, there has not been a more thorough public inquiry made on this subject.

This same view was taken of the application of electricity to street railway propulsion only three years ago. There was scarcely an engineer, a street car builder, a street railway constructor, or a capitalist who did not laugh at the claims which were made for it, and yet in this short time there has been a total revolution of feeling. There is not probably a street railway manager in the United States, who does not thoroughly believe that electricity is the present and coming power for street railways, and who, if he were constructing a new road, or re-equipping an old one, would not at once, or in the near future, adopt electricity if he could get the necessary rights to do so; and it should be borne in mind that the equipping of these roads has meant in very many cases the entire rebuilding of the track, the

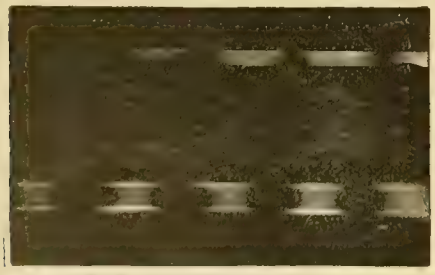

FIG. 4. A PHOTOGRAPHIC STUDY OF THE ELECTRIC ARC.

purchase of new cars, the building of costly stations, and in short the investment of a greater capital than had already been invested in the original plant, so that fifty million dollars is a small estimate of the sum which stands invested to-day in this one industry alone.

If, however, the commission is still in doubt, then in order to get a more intimate knowledge of what electricity can do as a motive power, it would seem proper,

First. That a time be set apart for the public examination of electrical engineers and contractors.

Second. To require a private statement from electrical engineers, confidential if desired, as to any new developments not publicly known.

Third. To visit two or three of the prominent electrical establishments to see what has been, is being, and what will be done, in general electrical machine construction.

Fourth. To then state what duty would be demanded of electric motors and what guarantees of performance would be required under forfeiture.

If something like this be not done, then I think it is safe to say that the rejection of electric motive power will be because of the following reasons: Novelty, accidents incident to the early period of its developments to outweigh in importance its demonstrated advantages, a conclusion that it is limited in capacity and development, and lack of information as to its past, present and promised future.

The motor equipment on, for example, the present London road is composed of one hundred horse power units. That required on elevated railroads is one hundred and eighty-five horse power. Attach four motors of the London type to the same circuit instead of two, govern them, as is perfectly feasible, by the same controlling device, and they will outwork any elevated road engine. Increase the dimensions in these machines one-third only, and two of them will do the work of this engine. Duality may be objected to, but it should be borne in mind that duality of engines is absolutely necessary in a locomotive for successful operation. It is not essential in an electric motor equipment, although advisable for traction purposes. But for that matter, double the dimensions of a London machine and it alone will outwork the two cylinders of the elevated locomotive.

Perhaps one of the most telling arguments in favor of electrical propulsion is the fact that in London another underground road to be operated by electricity is about to be constructed on plans already approved by a parliamentary

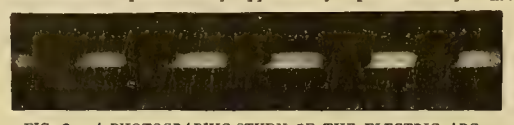

FIG. 3. A PHOTOGRAPHIC STUDY OF THE ELECTRIC ARC.

committee. This road is about six miles long and connects the West end with the city. It forms approximately a diameter of the oval described by the present steam underground railways. A 5,000-horse power station at the suburban end of the line will supply the current. The trains are to consist of six cars, seating about 340 persons and will weigh with the electric locomotives 120 tons. The average speed is to be fourteen miles an hour including all stops, with a maximum of about twenty-five miles an hour. Since this weight, power and seating capacity exceed that now common on the elevated railroads it is a somewhat practical answer to the objections made on this point.

There have been no demands for a 200-horse power steam locomotive, but there is not a builder in this country who, given suitable gauge of track and allowed dimensions of engine, would hesitate a moment to build a locomotive of that capacity.

So too, with electric motors. Given the incentive, and before the first foot of roadway is ready on the proposed rapid transit system of New York, a 200-horse power electric locomotive will be built which will, under forfeiture,

FIG. 6. A PHOTOGRAPHIC STUDY OF THE ELECTRIC ARC.

outwork any elevated road engine for speed, pulling capacity, steadiness of work, time of operation, and continuous mileage.

This statement is made from personal knowledge, and with an individual willingness to assume the risk.

What is the experience of other large cities in this matter of rapid transit?

In London the same interest which built the Greathead tunnel has been granted parliamentary rights for extensions, ordinarily most bitterly fought against, with an almost unexampled unanimity.

Paris is considering seriously the question of a great metropolitan underground electric system.

Boston has been advised after most careful investigation that the only proper system for the business portion of the city is an underground electric system.

As regards New York, while unnecessary delay is to be avoided, it is certain that no present delay is half so serious in its consequences as the adoption of an inferior plan, by reason of immature consideration, lack of knowledge or information, or in response to popular clamor.

As I close this paper there comes news of most reassuring character, for the chairman of the commission is reported as stating in the most emphatic manner that the commission is planning for future New York, and that it will under no consideration even consider the plans of the elevated railroad until after it has determined upon a route to satisfy the demands of that future.

It is also stated, presumably on the same authority, that a system and West side route from the Battery to the Harlem river has been definitely settled, part underground and part viaduct, and the announcement of this decision will be definitely made next Tuesday. If so, then it would seem that electricity has now the victory, and the particular method of construction and the route selected will form the subject of discussion.

The proposal has been made that Dungeon Rock cave, in the woods near Lynn, Mass., be lighted by electricity. The cave is interesting as a memorial of two men who spent their lives in a search after treasures which were never found. When the belt line cars stop within five minutes' walk of the entrance to the cave, the electricity would be easily furnished for the purpose. The road is expected to be ready for business June 1st.

A Photographic Study of the Electric Arc.[1]

BASED UPON EXPERIMENTS MADE BY J. C. MCMYNN.

BY EDWARD L. NICHOLS.

At the last general meeting of the institute Louis B. Marks read a paper on the electric arc, which dealt with the performance of commercial lamps in the continuous current circuit. The present paper is a preliminary report of a similar line of work now being carried on under the writer's direction by J. C. McMynn, the subject of the investigation being the alternating current arc. When the research in question is completed, Mr. McMynn will publish the results in full; but, since his report may not be ready

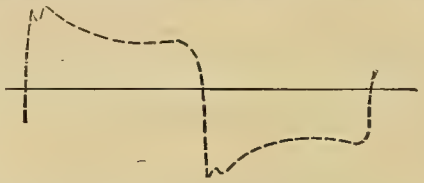

FIG. 2. A PHOTOGRAPHIC STUDY OF THE ELECTRIC ARC.

for several months, it seemed desirable that I should lay before the institute at this meeting certain points which have already been established.

The alternating current arc and the continuous current arc afford two entirely distinct fields of investigation. Candle-power, distribution of light, quality of light, temperature, efficiency, resistance, electromotive force necessary to maintain the arc, performance of the carbons under varying conditions; all of these are questions concerning which we have abundance of experimental data, so far as the continuous current arc is concerned. In the case of the alternating arc, however, these and many other points are still to be determined. The arc lamp fed by alternating currents invariably hums and sings. The note, which is not to be mistaken for the hissing which we hear from continuous current lamps that are burning under improper conditions, possesses a definite pitch, determined by the rate of alternation of the dynamo. That the note is not due to the mechanism of the lamp itself is readily shown. The Jablochkoff candle, which is devoid of all mechanism, sings as merrily as the lamp with solenoid regulator; any form of hand lamp will do the same. I do not remember having seen any definite statement concerning the source of this humming noise, nor any satisfactory discussion of the question. My attention was first brought to the very obvious explanation of the phenomenon by the study of certain curves of electromotive force, obtained by Messrs. Archbold and Teeple, in the course of an investigation of the alternating discharge between a ball and point.[2] These curves have recently been published. I reproduce one of them for the purpose of elucidation.[3] This curve was obtained by the well-known method of instantaneous contacts. The circuit under investigation was the high tension secondary of an induction coil, actuated by an alternating current dynamo, the electromotive force of which followed the law of sines closely. In the circuit were placed a ball and point, the air space between them being such that the discharge would take place in one direction only, from ball to point. It was established, by the use of a revolving mirror, that an arc existed only during that part of each cycle represented by the horizontal portion of the curve, *a—b*, Fig. 1. Shortly after this curve had been obtained, the curves of Messrs. Tobey and Walbridge,[4] illustrating the performance of the Stanley arc lighting dynamo, appeared. It will be remembered by those who heard their paper read before the institute that this machine, which gave very nearly the sine curve of electromotive force when working through non-inductive resistance, showed curves very widely removed from that form when arc lamps were in the outer circuit.

Fig. 2 contains the curve of the arc-lighting machine when five lamps were in circuit. The relation of this curve to those obtained with the ball and point is evident. Here, also the variation of the curve from sinusoidal form is to be ascribed to the periodic formation and breaking down of the arc, which happens twice in every complete cycle, instead of once, as in the case of the "one way" discharge of the ball and point phenomenon.

After studying these curves it seemed to me unquestionable that the humming of the alternating arc is due to the

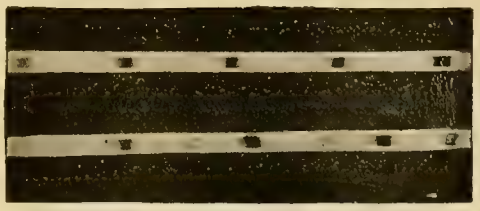

FIG. 5. A PHOTOGRAPHIC STUDY OF THE ELECTRIC ARC.

rapid periodic extinction and re-establishment of the discharge, the effect being similar to that observed in singing flames. When, some months later, opportunity was found of viewing the image of an alternating current lamp in the revolving mirror, I was prepared to witness the extinction of the arc during a definite part of each alternation. I do not know whether any member of the Insti-

1. Read before the American Institute of Electrical Engineers, New York, May 20, 1891.
2. See Archbold and Teeple; Thesis in MS., Library of Cornell University, 1889.
3. See "The Alternating Electric Arc between a Ball and Point," *American Journal of Science*, Vol. 41, p. 1.
4. Tobey and Walbridge; *Transactions*, Vol. 7, p. 367.

tute has tried this simple experiment. I have seen no description of it anywhere, although Wiedemann mentions the application of the revolving mirror to the study of the continuous current arc,[1] and Joubert[2] (1880) makes brief mention of a very ingenious appli cation of the plenakistiscope to the study of the changes to which the alternating arc is subject, during each period. When such a mirror, mounted upon a vertical axis, is set up at a convenient distance from the lamp, the images of the white-hot tips of the upper and lower carbons are drawn out by the revolution of the mirror into uniform, parallel bands, extending quite across the field of view. The intervening narrow strip, much darker, is the image of the arc itself. This region, however, is not uniform. It consists of alternate patches of purple and black, which mark the intervals during which the arc exists and is extinct.

Mr. McMynn's first step in the investigation which it is my purpose to discuss in this paper was to photograph the arc under conditions which will bring out this phenomenon. A camera with long bellows was set up near the lamp, the distances from plate to lens and from lens to lamp being such as to give a somewhat enlarged image of the arc. In the focal plane an opaque screen was mounted, which contained an opening just large enough to receive the image of the carbon points. The apparatus having been adjusted, a sensitive plate was driven past the aperture at high speed. The photographic image differed from that observed in the revolving mirror chiefly in the relative brightness of the arc proper, and of the incandescent carbon of the points. To the eye, the latter is the dominant feature; whereas the *actinic* image of the arc far exceeded in intensity that of the carbons.

These photographs establish the intermittent character of the alternating arc beyond question. They also exhibit in a new light many interesting properties of the arc, some of which are already well-known, while others have not been noted. Of the many negatives already obtained, a few characteristic forms are given in the accompanying plates.

Figs. 3, 4, 5 and 6 show the results obtained with plates moving in a horizontal direction, at right angles with the axis of the carbons of the lamp. Fig. 3 is an enlargement of one of the first negatives taken. The speed of the plate was moderate, the size of the image smaller than the arc itself. The plate contains but little detail. The carbons do not appear at all in the photograph, which shows little besides the periodic interruption of the arc. In later negatives the size of the image was greatly increased and the plate was driven much more rapidly through the field. In many instances two or more successive exposures were made upon the same negative. Inspection of Figs. 4, 5 and 6 shows that the greatest intensity resides neither in the arc itself nor on the incandescent carbons, but in a narrow region just at the end of the arc. In this region, which, doubtless, is that where the so-called "contact resistance" of the arc occurs, the illumination is sometimes intermittent as in Fig. 4; sometimes nearly uniform, as in Figs 5 and 6. The relative width of the intervals of darkness and of light is also seen to vary greatly under conditions not yet determined. Fig. 6 represents the highest rate of speed given to the plate in any of these exposures. The image of a single alternation was in this case extended almost across the plate. No new features were brought to light, however, by this process of magnification.

Figs. 7, 8, 9, 10, and 11 were obtained by driving ths plate vertically through the field, parallel to the carbons. An unlooked-for feature of all these plates was the oscillation of the arc from right to left in synchronism with the alternation period. Mr. McMynn suspected this vibration to be due to the action of the earth's magnetic field[3]. He was able to verify his view by comparing photographs made with the camera placed with its optical axis in the meridian with others in which the arc was viewed from the east or west. The disturbance was most marked in the former position, and disappeared almost entirely from negatives taken in the latter. This point is well illustrated by Fig. 8, *a* and *b* which shows the image obtained from the north and from the east. The lamp in this case was supplied with cylindrical carbons. All the other photographs represent the arc between flat carbons. In a strong field, produced by placing the arc nearly between the poles of a horse-shoe magnet, the lines of force being perpendicular to the axis of the lamp and parallel to that of the camera, the vibratory effect was much increased. See Fig. 7. The bearded appearance of the arc in Figs. 9, 10 and 11 is common to all the negatives taken while the arc was in the strong field. The spines are supposed to be the paths of very minute and highly incandescent particles, expelled from the arc at a considerable velocity under the action of the magnetic forces. A continuous current arc, also in a strong field, the conditions being as nearly as possible those under which Figs. 9, 10 and 11 were taken, gave a negative of which Fig. 12 is a very imperfect representation. The arc was flaming, and it will be seen that while the path of the arc itself is an unbroken, straight trace, the flames, which show themselves to the right and left hands, are irregularly intermittent. The negative shows, moreover, that the flame to the right hand, in the figure, is finely striated, reminding one of the image of a hissing, sensitive gas flame, as the latter appears in the revolving mirror. This vibration, which must represent a pitch of several thousand vibrations per second, is in all probability the cause of the hissing of the arc.

In this brief discussion I have left untouched many points which will suggest themselves to those who study Mr. McMynn's photographs. The interpretation of many of the features of these plates is at present rather obscure, but it is hoped that experiments now in progress will add something to our present knowledge of the phenomena connected with the alternating electric arc.

a. *b.*

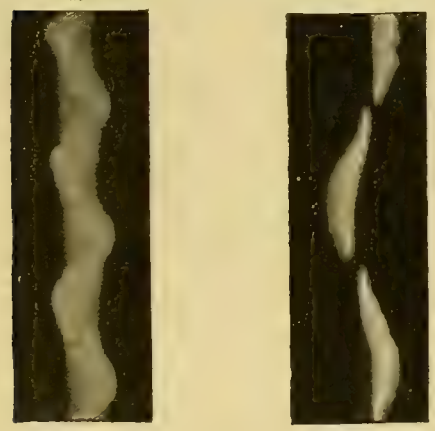

FIG. 7.

b. *a.*

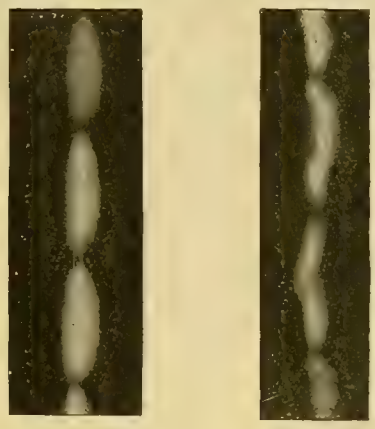

FIG. 8.

FIG. 9

FIG. 10

FIG. 11.

A PHOTOGRAPHIC STUDY OF THE ELECTRIC ARC.

1 Wiedemann, *Elektricität*, 1, p. 655.

2. Joubert, *Journal de Physique*, Vol. 9, p. 400.

3 It should be noted that Casselmann, as long ago as 1841, described the deflecting action of the earth's field upon the continuous current arc. (See *Poggendorff's Annalen*, 63, p. 588.

The Properties of Aluminum.

By Chas. M. Hall.

It has been stated by Prof. F. B. Crocker in an article on the "Properties and Production of Aluminum" that ninety-nine persons out of every hundred have entirely wrong ideas regarding that metal. This statement I am the more inclined to believe since reading Prof. Crocker's own article. His statements regarding the properties of aluminum are so wide of the mark and so misleading that they ought to be corrected. My reasons for undertaking to do this are that I have given a large part of the last five years to this subject; am largely interested in the production and sale of aluminum, and am familiar with its properties as shown by the experience of the past thirty years and by what is being done with it at present.

The main idea of Prof. Crocker's article seems to be that most of the supposed good qualities of aluminum really belong to its alloys, and are wrongly attributed to the pure metal. This may be true to a certain extent, in regard to the mechanical qualities of aluminum; but it shows a lamentable lack of information to say the same of its chemical qualities. Aluminum bronze, of the best grade, possesses 100,000 pounds tensile strength per square inch, and correspondingly high elasticity. The saying that aluminum is as strong as steel may have arisen from confounding the strength of aluminum bronze with that of pure aluminum, or it might equally have arisen from the fact that a comparison of specimens and equal weights shows aluminum to be as strong as good specimens of steel; thus the tensile strength of aluminum, 26,000 pounds, multiplied by three, for difference in specific gravity, gives 78,000 pounds, whereas the best structural steel ranges from 60,000 to 70,000 pounds per square inch.

Again, Prof. Crocker says that aluminum has only one-third the strength of wrought iron. He must show a remarkable specimen of wrought iron with a tenacity of three times 26,000 pounds per square inch to prove this assertion. The best quality of wrought iron runs from 48,000 to 50,000 pounds per square inch tenacity; so that aluminum has over one half the strength of wrought iron, section for section, and, weight for weight, is considerably stronger than wrought iron.

I am not trying to prove that aluminum is a suitable material for structural purposes, where strength is the main object. It is not, and neither is any other metal aside from iron and steel. But aluminum does compare well in strength with other metals, and for purposes where lightness, combined with moderate strength, is desired, not only will it become useful, but it is being largely used to-day.

It is doubtful if any one has been seriously misled by any confusion between the strength of aluminum and that of aluminum bronze, or if any well informed person has proposed to displace iron and steel for structural purposes with aluminum.

The most serious objections which Prof. Crocker urges against aluminum are on the score of its chemical properties, and here his information and reasoning are really unique. "Aluminum bronze," he says, "is remarkably free from tarnishing." "Therefore, freedom from oxidation is another property that is wrongly attributed to aluminum itself." It is true, aluminum bronze is the best of the copper alloys for resisting oxidizing influences, but for the vast majority of uses to which metals are put, it cannot compare with pure aluminum in this respect. Aluminum here ranks with silver, and next to gold and platinum. The fallacy of Prof. Crocker's reasoning will be apparent to any one who possesses an aluminum opera glass, or who is acquainted with the fact that next to gold aluminum is the metal most preferred by dentists for dental plates, etc., or that for sign painting and decorative purposes, aluminum leaf has the preference over silver leaf, because aluminum remains bright and silver blackens. What are the facts in regard to the corrodibility of aluminum? In the first place it is not true generally that "it is equally attacked by acid." Of the common reagents it is dissolved only by hydrochloric acid, and by the alkaline hydrates or caustic alkalies. Sulphuric and nitric acid act upon it with extreme slowness, not dissolving it appreciably after several days' exposure to their action. But for all ordinary uses it is no more against aluminum than against gold that it is dissolved by aqua regia or selenious acid. These strong chemical reagents, the acids and caustic alkalies, are practically unknown outside the laboratory and chemical manufactory. Because of their strong affinities, they cannot exist in our common surroundings of air, water, food, etc.

The action of the weaker organic acid, saline solutions, etc., upon aluminum is much less than any other metals except the noble metals. Alkaline carbonates do not dissolve aluminum, nor does soap, as Prof. Crocker states. Air, wet or dry, has absolutely no action on aluminum, nor has water. If it is true, as stated by Prof. Crocker, that "subjected to ordinary moist air, aluminum tarnishes and oxidizes rapidly," I am unable to see the pertinence of his further remark that "it is not affected by sulphur or sulphureted hydrogen, which is a great advantage." For a metal that is oxidized rapidly by moist air, there would be small use in resistance to sulphur or sulphur gases. Prof. Crocker states that "the ease of oxidizing" aluminum is "about equal to other metals, such as tin, zinc and iron." The absurdity of this statement would be almost evident to one who had ever seen an article made of aluminum. Think of iron or tin dental plates, or of zinc leaf or sheet iron used for decorative purposes as aluminum sheet, foil, and leaf are employed. Prof. Crocker constantly asserts that "aluminum really has excellent qualities." I am unable to see what they are on his authority.

One of my associates became interested in aluminum financially largely because of an aluminum field glass which he has possessed for twenty years. He has carried it all over the world. It has been wet with sea water and has been almost constantly exposed to "ordinary moist air" for twenty years and it has never been cleaned or polished further than wiping it with a handkerchief, and today it retains its polish and luster as perfectly as when new. The fact is that for resistance to all ordinary corroding and oxidizing influences aluminum stands next to gold and platinum and ranks equal with silver, and the difference between it and the latter metal, aside from difference in color (aluminum being of a bluish tint, which makes silver look yellow by comparison) is just this: For objects that require much handling aluminum has the disadvantage of losing a portion of its polish, probably from coming in contact with perspiration; but where it is to be exposed to the air of a house or the weather, without much handling, there is no metal which will retain its luster and polish better. Silver is blackened by exposure to the air, where aluminum is unaffected, while where aluminum is dulled and requires polishing, silver requires the same.

The foreign workers in aluminum seem to have succeeded in giving a more permanent polish and luster to aluminum under handling than we have in this country, as I judge from some aluminum articles obtained abroad. Where polish is unimportant, as for dental plates and culinary utensils, aluminum has no superior short of the noble metals. As regards aluminum cooking utensils, I am not giving this statement off-hand, but from actual experiments extending over more than a year. Cooking utensils of aluminum have been in constant use for the time stated, have been daily subjected to boiling saline solutions, washing with soap, etc., and as a result they are preferred by the users to utensils of any other metals, one reason being that they always are clean and white, while the nickel rivets used for fastening the handle to some of them became perfectly black. The same qualities of aluminum are shown by the fact that aluminum vessels have been

used for a considerable time for the manufacture of jellies, where freedom from discoloration is important, and besides are now being extensively used by one of the large canning concerns in Pittsburg, whose name and products are widely known.

The perfect antiseptic qualities of aluminum should also be noticed, which render it the best metal for culinary uses on this account, and also recommend it for surgical instruments, for which it is largely used at present.

So far as the working qualities of aluminum go, it is well known to be one of the most ductile and malleable of all metals, and therefore is very easily rolled into sheets or drawn into tubes or very finest wire. Naturally possessing such a high grade of ductility, the metal is of a tough nature, such as would not admit of easy working qualities in the lathe or in the planer; but this toughness or clinging tendency of its fibers can be readily overcome, and the metal very easily machined by simply alloying with 3 or 4 per cent. of metallic copper, which shortens the grain, but which does not interfere or change the other qualities or virtues of pure aluminum.

I am glad to see that Prof. Crocker truthfully gives aluminum credit for electrical conductivity, comparing equal weights, twice that of copper. This may be of great importance at no distant day, because, comparing equal weights, aluminum has about twelve times the conductivity of iron, and while it may not soon compete with copper for insulaled wire, it is quite likely to compete with iron for telegraph wire, especially when its perfect durability on exposure to the weather is considered and as hard drawn aluminum wire can readily be made having a tensile strength of at least 60,000 pounds per square inch. There is one of the electrical properties of aluminum of which no mention is made by Prof. Crocker, but which is interesting, although it has not been much investigated nor turned to any practical use. This is its resistance to the destructive effects of the electric spark. Aluminum is superior in this respect to all other metals, and for this reason is employed by Prof. Crocker and others for electrodes in vacuum discharge tubes when electrodes of other metals are quickly torn to pieces. The question suggests itself as to its use for commutators and other electrical purposes, where such a quality is most important.

In the last of his article, Prof. Crocker makes the strange statement that "the purity of aluminum does a great deal toward improving its quality," which indicates possibly that the aluminum upon which his article is founded is not aluminum at all, but that metal plus a considerable amount of iron, silicon, sodium or zinc. His remarks would be very pertinent in regard to such a compound. In this connection, it may be stated that it was never easier to obtain aluminum of the purest quality than at present, since the electrical process has been fully perfected.

The conclusion of Prof. Crocker is that aluminum "is not a promising material for practical use." My belief is just the contrary, and it is founded upon a careful study of the metal and upon the practical tests made of its properties extending over several years, and made with large quantities of metal. There is no more promising material for investigation for practical use; and it has been proved that for a multitude of uses the same results in utility, beauty and durability can be obtained from aluminum, at a less cost, than from any other metal whatever.

In a paper on aluminum read last winter before the Boston Society of Arts Alfred E. Hunt, in order to give a new turn to a discussion that had fallen into a rut, ventured the statement that aluminum had been overrated, as it has by some of the unscientific papers. But now every one writing about the metal has taken the cue until aluminum has no good qualities left whatever, but is a weak, easily corrodible metal, like zinc or tin, and really "takes up more space than it is worth," and has falsely appropriated the good qualities of its alloys. Aluminum has been overrated. There has been a kind of "glamor" associated with it, due to two facts, the first being that it is really useful, durable and beautiful, combined with the other fact, which has little to do with its commercial importance, that its ores are more abundant than of any other metal and constitute a large portion of the earth's crust.

The world has been centuries in learning to use other metals; in learning to roll, draw, temper and polish them. Aluminum is new, but we are learning how to deal with it, how to secure the qualities of strength, hardness, ductility, luster, etc., where required, much more rapidly than has occurred in the history of the other metals.

Toronto Street Railways to be Operated by the City.

The city officials of Toronto, Ont., have assumed control of the street railways of that city, paying the company $1,453,788 for the property. The transfer was made under a clause in the company's franchise which provided that the city might assume ownership at the end of twenty years upon payment of a fair valuation decreed by arbitrators. The city acted upon this reversion clause, arbitrators were appointed, and the sum mentioned above agreed upon. The company fought the case at every step and employed the best legal talent obtainable in its efforts to hold the franchise. The courts have finally decreed against it, the money has been paid, and the city is now the sole owner of the entire street car system, operating it or leasing it in the future at its own option.

Commenting on this, the Chicago *Herald* says: "This is a grave experiment. It is state socialism on a plane that will be watched from every point of the northern half of the continent. "It may be urged that there is no more of state socialism in operating surface roads than in managing water plants or gas works. In principle there is not. But the question of expediency has to be taken into account in each proposed case of projected socialism. Suppose that the present city administration operated the cable roads of Chicago. Political influence, never more paramount than now, would directly affect their management. Heads of divisions, superintendents and their assistants, expert mechanics, experienced accountants, all would have to go, and the ward workers who were active in getting up delegations, officers of ward republican clubs, men connected with various creed or national societies, and the personal following of politicians of every shade and degree, would be put into the vacant places. We have accidents enough now in the tunnel and elsewhere."

Chicago Elevated Railway.

Press dispatches announcing that electricity is to be used as the motive power for the new rapid transit system in New York city were read with much interest by the officers of the Chicago & South Side Rapid Transit Railroad company, as a portion, at least, of the New York system is to be elevated. The Chicago elevated line is to be in operation in the fall as far south as Thirty-ninth street, and the engineers have naturally devoted much attention to the subject of motive power. In speaking on this subject to a representative of the WESTERN ELECTRICIAN, Chief Engineer Sloan said: "We shall use locomotives at first, but they will be more powerful than those now used on the New York elevated roads. I have no doubt that electricians will some day be able to solve the problem of electric traction for heavy trains on elevated structures, but they have not done so yet. When they do, we will be glad to give electric motors a trial. But we cannot afford to do the experimenting; the electrical people must do that themselves. I should think, however, that by the time the World's Fair opened, the desired result would be accomplished."

Mr. Sloan said that he had not heard of the Bergman electric locomotive alluded to in the dispatches, and added that he had sent to New York for information.

Addition to the Chicago Edison Station.

The rapid growth of the business of the Chicago Edison company has made numerous additions to its plant necessary. The new South Side station has only been in operation a month or two, and now arrangements are making for a large addition to the Adams street station. The new machinery will consist of four Armington & Sims engines of 400 horse power each, three Heine boilers, each of 375 horse power capacity, and eight No. 60 dynamos. This will make the total capacity of the steam plant at this station 3,600 horse power.

The Chicago Electric Club.

The meeting of the Chicago Electric club held on Monday evening, May 25, was one of the most interesting of the season. Prof. H. S. Carhart of the University of Michigan read the paper of the evening, which was entitled "Armature Reaction in Constant Current Dynamos." Before the assembling of the club members Prof. Carhart was entertained at dinner by the board of managers. The paper was read immediately afterward. Following the literary entertainment was a discussion of club business. Chairman W. B. Pearson, of the committee appointed to organize the independent restaurant service, reported that the arrangements undertaken by his committee had been practically completed, and that, commencing May 26, a business lunch would be served from 12 to 2 and dishes could be ordered at any time during the day or evening up to 11 P. M. The announcement of the inauguration of the restaurant service was received by the club with hearty applause, and a number of complimentary allusions were made to Chairman Pearson's energetic efforts.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 23.—Next Tuesday the Rapid Transit Commission will make public its solution of the transit problem. The people are ready to hear that electricity has been found practicable as a motive power. It is reported that Chairman William Steinway to-day made the statement that a four-track system operated by electricity to be constructed underground in certain districts, and elevated in others where it is practicable, would be recommended. Forty miles an hour is the speed aimed at, and the four tracks will admit of express and way trains. The public will have an opportunity to discuss and criticise the project before it may be finally adopted and submitted to the Board of Aldermen and the property owners along the proposed route.

It is Mr. Steinway's judgment that the proposed structure can be built in eighteen months, at a total cost of perhaps $50,000,000. The up-town section, he thinks, should be running in eighteen months.

The term of the Board of Electrical Control has been extended one year from next fall by an act of the legislature.

It is interesting to note the lightning work of the transatlantic cable service. Last Wednesday a prominent gentleman said: "To-day at 9:15 A. M. I sent my messenger with a telegram for Paris to the office of the cable company. At 11:37 A. M. the answer to same reached this city, and came into my hands about ten minutes later, which I consider a marvelous feat indeed."

The vacancy in the Board of Electrical Control caused by the resignation of the late Daniel L. Gibbens has been filled by Gov. Hill, who appointed ex-Alderman Walton Storm, a Tammany man, from the great Twenty-first district.

The Fire Commissioners have adopted Commissioner Robbins' recommendation for the appropriation of $775 to be used in placing cables in the subways, and connecting hospitals with the fire department. W. H. T.

Detroit, Mich.

DETROIT, Mich., May 23.—Wells W. Leggett, president of the Brush Electric Light company of Detroit, died recently at his residence in this city. He was taken sick on May 3d with malaria. Erysipelas set in toward the last of his sickness, and his death resulted from inflammation of the brain. He was the organizer of, and a large stockholder in, the Brush Electric Light company of Detroit, and also interested in the original Brush company of Cleveland.

Mr. Leggett was born in Ohio in 1847. At fifteen he entered the army as clerk for his father, who was colonel of an Ohio regiment. In 1864 he was commissioned captain of volunteers by Abraham Lincoln, and acted as engineer officer on Gen. Blair's staff. After the war, at the age of eighteen, he entered West Point, from which academy he graduated.

The street railway company at Grand Rapids have lost thirty summer cars by a fire in that place.

On Tuesday of this week the employes of the Grand Rapids Street Railway company struck for an advance of pay. The company has refused to grant it, and the strike is still on. No violence has been committed, and the strikers seem to have the sympathy of the people, who are walking. G.

Pittsburg, Pa.

PITTSBURG, Pa., May 23.—There are now five electric railroads in actual operation in this city, the last one, the Duquesne Traction road, beginning operations on May 21st The company was organized about a year and a half ago Immediately afterward, twelve ordinances were introduced in the Pittsburg councils to give the company franchises for running its lines over the most important streets of this city. The distance covered by the tracks owned by the company is over twenty-eight miles. The company has sixty cars in operation, and each one is equipped with two motors. The operation of this road affords the citizens a third direct line of rapid transit from the business portion of the city to the East End and Wilkinsburg, a direct line of about seven miles. The foundations for the road bed are concrete on which oak cross-ties rest and support the steel girder rail. The space between the tracks and for one foot outside is paved with Ligonier block. The cars were made by the Pullman Palace Car company, and are of the finest finish. The trucks have eight wheels.

The car station of the company is located on the corner of Craig and Neville streets, where there are also the offices of the company, as well as the repair and machine shops. This building is a substantial brick structure, with slate roof, supported on iron rafters, giving a space

inside for the storage of cars of 400x140 feet, in which there are no pillars. There is storage room for one hundred cars, with ample examining pits.

The power house of the company is situated at Ben Venue station on the Pennsylvania railroad. The dimesions of this building are 150x130 feet, and it is also built of brick. It is supplied with twelve dynamos of 100 horse power each. Power is furnished by two engines of 600 horse power each, and one pair of 300 horse power each, making 1,800 horse power in all. In an adjoining room are located the boilers, ten in number, placed in two batteries, giving ample reserve in this branch of the station equipment. The switch-board is fully supplied with all the latest controlling and measuring devices.

In addition to the usual trolley wire used in connection with this system, and which is supported in a substantial manner on iron pipe poles, there are also about sixteen miles of heavily insulated feed wire, supplying the trolley wire at different points. The overhead line is subdivided into seven sections, any one of which may be cut out without interference with the rest of the line. The cars, like those in operation on the cable roads in Pittsburg, are equipped with double trucks, and ride as smoothly as those in use on the cable lines, avoiding the swinging motion of ordinary cars. The line was equipped by the Thomson-Houston company. E. H. H.

PERSONAL.

H. A. Kinney, general agent for the Detroit Motor company, with headquarters at Omaha, was in Chicago on Saturday last.

D. B. Dean, traveling representative of the Electric Merchandise company, Chicago, has just returned from a successful eastern trip.

E. E. Keller, for the last four years Chicago manager of the North American Construction company, has retired to take a position with the Fort Wayne Electric company, and henceforth will be found at its offices, 185 Dearborn street, in charge of the local business.

George D. Shepardson has resigned his position as instructor in physics in Cornell University in order to take charge of the department of electrical engineering in the University of Minnesota. Mr. Shepardson is a graduate both of Denison College and Cornell University, and has had a wide experience in the theory and practice of electrical engineering.

C. A. Brown, manager of the Western Electric company, Chicago, will retire from his position June 1st to engage in the practice of law. Mr. Brown has formed a copartnership with George P. Barton. The firm will make a specialty of patent litigation. The offices will be in Temple court, Chicago. Mr. Brown has been prominently identified with the electrical interests for many years. He has been successful as a business man and his experience has given him a knowledge of electrical patents that will prove extremely valuable in his new field. Mr. Barton has established a lucrative practice and has attained an excellent reputation as a patent lawyer. The firm will start with bright prospects and will have the best wishes of the electrical fraternity.

NEW INCORPORATIONS.

Virginia & Carolina Heat & Light company, Danville, Va.; capital stock, $300,000.

Hersch & Ellerbeck Electric company, Salt Lake City, Utah; capital stock, $10,000; to deal in mechanical and electrical appliances.

Palmer Motor company, Portland, Me.; capital stock, $1,000,000; to manufacture and deal in all kinds of electrical appliances.

Southern Branch Development company, Norfolk, Va.; capital stock, $50,000; real estate, building, water, electric and gas works.

Baar Lithia Development company of Virginia, Front Royal, Va.; capital stock, $157,500; real estate, hotels, buildings, electric lights, etc.

Sunny South Wood Manufacturing company, Portsmouth, Va.; capital stock, $75,000; wood, fuel, wooden ware, steam and electric power.

Whitney Electrical Instrument company, Saco, Me.; capital stock, $500,000; to manufacture and deal in electrical apparatus and machinery.

Steelton company, Steelton, Va.; capital stock, $1,000,000; mining coal and minerals and manufacturing electric and waterworks, roads, etc.

Dunellen Electric Light company, Dunellen, N. J.; capital stock, $5,000; the manufacture and sale of electricity to be used for light, heat and power.

Batavia Improvement company, Chicago, Ill.; capital stock, $500,000; to build, equip and operate street railways to supply water, light, heat and power.

Queen City Electric Street Railway company, Marion, Ind.; capital stock, $150,000; to construct and operate a street railway in the city of Marion, Ind.

National Electric Valve company, Cleveland, O; capital stock, $100,000; manufacturing, selling and dealing in electric valves, pumps and other devices, etc.

New York Heat, Light & Power company, New York, N. Y.; capital stock, $50,000; producing electricity for heat, light and power in cities and towns in New York state.

Underground Electric Traction company, St. Louis, Mo.; capital stock, $100,000; to acquire a patent for an improvement in electric railways and to introduce said invention.

Post Engineering company, Portland, Me.; capital stock, $100,000; to manufacture, deal in and lease all kinds of machines, machinery, electric lighting plants and apparatus.

Conduit Wiring company, New York City; capital stock, $10,000; furnishing and fitting up of buildings, cars, vessels, tunnels and other places with light, heat, etc., produced from electricity.

Paterson Electrical Manufacturing company, Paterson, N. J.; capital stock, $100 000; the manufacture and sale of electrical motors and other machines and articles operated by electricity.

Edinburg Ice and Light company, Edinburg, Ind.; capital stock, $30,000; to manufacture and sell ice and to furnish electric lights for public and private use in said town of Edinburg, Ind.

Springfield Electric Railway company, Springfield, O.; capital stock, $50 000; building or acquiring, a street railway to be operated by electricity or any motive power other than steam.

Crescent Electric Light company, Long Island City and Newtown, N. Y.; capital stock, $25,000; manufacturing and using electricity for light, heat and power in Long Island City and Newtown.

McLean Engineering company, Hoboken, N. J.; capital stock, $30,000; to place and install electric motors and isolated electric plants, to build and operate steam plants, street railways, mills, machinery, etc.

Mount Pleasant Electric Light, Heat & Power company Mount Pleasant, Pa.; capital stock, $5,000; supplying light, heat and power by means of electricity.

Clinton Electric Light & Power company, Clinton, Vermillion county, Ind.; capital stock, $10,000; to manufacture electrical currents and to furnish same to the town of Clinton, and the citizens thereof for the purpose of light, heat and motive power.

Noblesville Water & Light company, Noblesville, Hamilton county, Ind.; capital stock, $50,000; to construct and operate waterworks in the city of Noblesville, and to, purchase and provide engines, boilers, machinery, pipes, mains and appliances necessary to supply said city with water, and construct and operate an electric light plant.

Syndicate Land & Improvement company, Portland, Ore.; capital stock, $67,000; purchase, acquire, plot and resell lands and town lots, and to construct and equip a railroad from the city of Portland toward the Cascade mountains in the state of Oregon or otherwise, the same to be operated either by steam or electrical appliances or other motive power.

ELECTRIC LIGHTING.

Palatka, Fla., people are talking of erecting an electric light plant.

It is reported that electric lights are to be introduced in Marlin, Texas.

The United Electric Light company of Springfield, Mass., will increase its capital stock from $300,000 to $400,000.

An electric light plant has been installed in the Mare Island navy yard, San Francisco. The Thomson-Houston system is used.

An electric light company will be established to furnish light to Perth, Fremantle and Albany, the three most important towns in Western Australia.

The city council of Mobile, Ala, has recently adopted a resolution appointing a committee to investigate methods of street lighting by electricity, and it is possible that the city may determine to erect its own plant.

An isolated plant consisting of one incandescent and three arc light dynamos will be installed in the basement of the Sibley, Lindsay & Curr building in Rochester, N. Y. Provision will be made for 300 incandescent and 150 arc lights.

ELECTRIC RAILWAYS.

An electric street railway is talked of at Montgomery, Ala.

Surveys are being made for the proposed extensions of the electric road.

A company has been organized to build an electric road in Anderson, Ind.

The construction of an electric road from Kanawha City to Charlestown, W. Va., is proposed.

The Maplewood electric railroad at Nashville, Tenn., will be two and a quarter miles long.

The Augusta, Ga., Electric Railway company has a special ticket for school children sold at half price.

It is reported that the electric street railway at Port Townsend, Ore., upon which work was suspended some time ago, is to be completed. It will be four and a half miles long.

The Cicero and Proviso electric railway, recently described in this paper, is meeting with great success. On a recent Sunday nearly 10,000 persons were carried with only twelve cars.

It is stated that arrangements have been completed for the building of an electrical railroad from Pell City, Ala., to some point on the Coosa river. The Thomson-Houston system is said to have been adopted.

Creditors representing claims amounting to nearly $20,000 have filed liens against the Key City Electric Railway company of Dubuque, Ia., and it is possible that the road willbe consolidated with the Allen & Swiney system. J. K. Deming has been appointed receiver.

The contract for the entire electrical equipment of the Memphis, Tenn., electric railway system has been awarded to the Electric Merchandise company of Chicago. The contract includes all material for line and track construction, including poles. The system embraces 40 miles of track.

In the case of Frederick Schlegel, a prominent florist of Rochester, N. Y., who was killed by being struck by an electric car while crossing a street in that city, the coroner's jury returned a verdict exonerating the company, and attributing the accident to carelessness on the part of the deceased.

The stockholders of the Union Electric Street Railway company of Saginaw, Mich., have voted to spend $100,000 at once in extending their system. A new power station will be erected, and an equipment of twenty new cars ordered. A considerable portion of the main line will be double-tracked.

It is proposed to connect a number of towns in Central Pennsylvania, from Duryea to Nanticoke, by a system of electric roads, for which a company has already been formed and a large capital subscribed. The proposed line is to commence at Duryea and pass through the towns of Pittston, Wyoming, Kingston, Wilkesbarre, Plains, Parsons and Pleasant Valley. The intention is to furnish cheap and rapid transportation, and thus bring the several communities into closer relationship.

It is expeced that the project of establishing an electric railway betw en Rochester and Buffalo will be pushed to a speedy completion. The committee representing the company which visited Lockport, Tonawanda, Buffalo and Niagara Falls last week reports that the scheme has been favorably received by capitalists in all these towns and will be liberally encouraged. It is proposed to perfect the organization immediately, secure the necessary capital, and begin operations without delay.

ELECTRIC MINING.

Speaking of the application of electricity in mining operations, R. S. Hunton, a prominent mining man of Aspen, Colorado, says: "This force promises to inaugurate a new era in the production of silver, and to bring to the front many districts that have hitherto been unimportant factors in the mineral output of the country. Some of our high mountain mines have been almost valueless because of the difficulty and expense of transporting fuel to the places where it was needed. This difficulty in the way of profitable production has been in a great measure overcome by the substitution of electric for steam power, and I know of a dozen mines at least that are operated by the new motor. In most of the high camps there is an abundance of water, which can be applied at a small cost to produce electricity. When the motor is more fully developed, many mining districts, now insignificant, will become very important."

TELEGRAPH.

In questioning an assertion of the *Mechanical World* to the effect that a deep sea cable has a life of only about ten years, the London *Electrical Review* says: "There are now in existence and in working order, about 44,000 knots of cables, having a life of fifteen years and over; of this amount some 21,000 knots is twenty years of age and over. There are several instances of cables now working over twenty-five years old, but these are principally lines of unimportant lengths, and lying in shallow water. The cables we have cited are laid in all portions of the globe, and submerged in all sorts of depths; and although the companies owning them have spent, and are prepared to expend, considerable sums in repairs, we do not think that the complete renewal of each section every ten years has entered into their calculation. Present experience would lead us to allot to submarine cables laid under favorable conditions an average life of from thirty to forty years, but no hard and fast figure can be given any more than it is possible to determine the number of years that each newly-born child will live."

TELEPHONE.

According to the *Bulletin International del' Electricite*, the 1st of May "manifestants" managed to cut some 600 underground telephone wires in Lyons, France.

The proposed law for the acquisition of the Italian telephone system will shortly be laid before the parliament of that country, and it is expected that it will pass both chambers before the end of June.

Quite a sensation was created at Lansing, Mich., last week when the *News* of that city openly charged Samuel E. Watson of Grand Rapids, general superintendent of the Michigan Bell Telephone company, with being guilty of a wholesale attempt to bribe members of the senate to smother the bill reducing telephone rates.

MISCELLANEOUS.

Dr. Selwyn, director of the Canadian geological survey, thinks that in the peculiar petroleum-saturated sand found in the Athabasca district in Canada he has discovered an excellent insulating material for underground electric wires.

The Okonite base ball club is preparing for the summer campaign, and during the Saturday afternoons in June can be found sprinting around one of the diamonds in Jackson Park. It will receive challenges at the office of the Central Electric company.

TRADE NEWS.

The Jeffrey Manufacturing company of Columbus, O., and Baker & Whitmarsh of Abingdon, Mass., add their voices to the chorus of praise for the Ball engines.

H. H. Pattee of Monmouth, Ill., was in the city last week looking after the interests of his "Lamp Hour Recorder." This is used in a number of places instead of a meter.

A beautifully illustrated "advance sheet" has been issued by the Colburn Electric Manufacturing company of Fitchburg, Mass. Cuts of incandescent lighting dynamos, motors and electro-depositing machines are shown.

Hereafter the headquarters of the Moore Electrical Manufacturing company of New York, will be found at 652 and 654 Hudson street, the company having lately removed. A full line of electrical goods of all descriptions will always be found in stock.

The Central Electric company, Chicago, has been awarded the contract for furnishing the wire for the Fair building, Chicago, which, it is claimed, will be the largest retail establishment in the world. Okonite will be used throughout the building.

D. Forsythe Morris, a member of the firm of Milliken Bros., New York, and their western representative, returned from the East Monday night, where he had been in consultation with his associates. This firm manufactures the Milliken iron pole for street railway and electric light purposes, and represents the Phœnix Iron company of Trenton, N. J., large manufacturers of structural iron.

The new style Paiste switch socket shell is greatly reduced in size, making it the smallest socket on the market. Great care and attention were given to the manner of connecting the wires. By an ingenious device the wire man can use his discretion between a binding post or a binding screw. When in the act of wiring, both shells can be removed from the socket, leaving a clear, unobstructed place to work. By means of a yoke and collar the socket can be securely fixed to a chandelier, and under no circumstances, it is claimed, can the shell short-circuit the wires. All insulating parts are made of Syracuse china.

The recently organized firm of Kohler Bros. & Grier will start business on June 1st with offices at 341 Rookery building. Thos G. Grier, G. A. Edward Kohler and Franklin W. Kohler will compose the firm. This house will act as the western branch of H. T. Paiste of Philadelphia, making all sales and shipments direct from Chicago for the entire western territory. The concern will handle the Eddy electric motors and generators, and will give special attention to the introduction of electric light and power specialties. The reputation of the gentlemen composing this new organization would seem in itself to be a sufficient guarantee of success. They are energetic and hard-working young men.

Much interesting information is contained in a recent circular issued by the Pelton Water Wheel company of San Francisco, whose products have a world wide reputation. This system is particularly applicable at waterfalls where the head is great but the supply of water limited. It is claimed that the Pelton wheel "has added from twenty to twenty-five per cent. to the usual effect of water under all ordinary as well as extraordinary conditions." In the Chollar shaft on the Comstock lode a Pelton wheel is operated under a vertical pressure of 1680 feet, showing under this extraordinary condition an average of efficiency of 88 per cent. It is believed that they could be run equally well under twice or three times this pressure, were so high a head obtainable.

The Engineering Equipment company has moved from temporary quarters at 73 Cortlandt street to attractive offices in the new Central building, 143 Liberty street, N. Y. The company still retains the premises at 73 Cortlandt street for stock of belting, wires, etc., which it carries for convenience of customers who can not await shipment from the factories. F. L. Perine is general manager, A. L. Tinker secretary and treasurer and F. A. Magee electrician. The company has been formed to handle first-class steam and electric equipment materials. Among the specialties which the company controls may be mentioned more particularly the following: The Underwood cotton-leather belts and belting specialties, Anderson line materials, including the Boston trolley for electric roads; the Habirshaw wires, cables and cores; the patent indurated fiber pipe for electrical and other subways, and the new Kellogg steel center and side poles. For the latter the company is sole agent. Boilers and engines, wooden poles, cross arms, cars, trucks, etc., are also handled.

BUSINESS.

The Central Electric company offices and salesrooms on Franklin street were given over last week to paper hangers and decorators engaged in cleaning house for the summer.

An attractive little pamphlet sets forth the advantages of the fan motors recently brought out by the Stanley Electric Manufacturing company of Pittsfield, Mass., and illustrated recently in this paper.

L. J. Wing & Co., 126 Liberty street, New York, announce three specialties—the Regan gas engine, the Dake steam engine and Riker dynamo combination and the Wing fan and motor combination.

Large orders for Safety insulated wire are reported by the Knapp Electrical Works of Chicago. Of these a large proportion were for lead covered cables for underground work. The Safety well deserves its popularity.

George Cutter is still keeping his combination tin shades to the front. At present there are over 45,000 of them in active use. He is also sending out "barrels of insulation" in the shape of Simplex paint, large orders for which have been received from mining districts.

Ritchie's catalogue of electrical test instruments is out. The quality of the instruments turned out by E. S. Ritchie & Sons of Brookline, Mass., is of the highest order, and the house well deserves the support it has received. Many new descriptions are included in the new catalogue.

George L. Kirkham, manager of the Northwestern Electrical Specialty company, Chicago, reports a week of great activity with the Economic incandescent lamp. Orders have been received from Ohio on the east, Washington and California on the west, and Texas on the south. This lamp seems to be rapidly gaining public favor.

Attention is called by the Conduit Wiring company, 12 West Twenty-ninth street, New York, to the fact that "the conduit system is the only means of preparing buildings in course of erection or alteration for the future reception and concealment of the wires themselves in cases where it is desired to do this without the immediate investment in the cost of the conductors, and at hardly any greater ultimate expense than if they were put in at once."

The Vulcanized Fibre company of Wilmington, Del., has issued a new and convenient catalogue and price list. Vulcanized fiber is produced by treating specially prepared vegetable fiber with powerful chemical agents, whereby the exterior portion of each separate fiber becomes glutinous and while in this condition the whole mass is consolidated under very heavy pressure, and becomes practically homogeneous. After this the chemicals are extracted, the mass is manipulated, rolled, pressed and cured by various methods, and the result is vulcanized fibre. This material is said to form an excellent insulator in all dry positions. It is remarkably strong and can be tapped, drilled and screw-threaded.

ELECTRICAL PATENTS.

Issued May 19, 1891.

452,359. Electric Switching Apparatus. George T. Briggs, Windsor, Conn.

The invention has reference to switching apparatus adapted for reversing electric motors and controlling their speed.

452,367. Electric Light Fixture. John G. Fisher, East Saginaw, Mich.

452,392. Self Winding Clock. Frederick M. Schmidt, Brooklyn, N. Y.

This invention is an improvement in that class of clocks commonly known as "self-winding," or, in other words, clocks that are run by means of a weight or spring, but which at predetermined intervals are automatically wound by means of an electro-magnetic motive device. The object of this invention is to simplify the mechanism which such clocks contain and to provide for the least possible drain upon the battery used to supply the motive power for rewinding them.

452,397. Electric Push Button. Max Straus, Baltimore, Md

452,420. Dynamo Electric Machine or Motor. Ferdinand A. Wessel, Brooklyn, N. Y.

The first claim reads as follows:

"In a field magnet for dynamos, etc., a laminated magnet-core composed entirely of L shaped laminæ of the same form and dimensions applied upon each other and having their yoke pieces or extensions overlapping each other and extending in opposite directions entirely through the field-magnet coils wound upon them, in combination with fastening-bolts passing through said L shaped pieces at the angle of the pieces whose pole portions are at one end of the coil and through the ends of the L-shaped pieces whose pole portions are at the opposite end of the coil.

452,422. Controlling Device for Electric Motors. Francis O. Blackwell, New York, N. Y.

452,423. Controlling Device for Electric Motors. Francis O. Blackwell, New York, N. Y.

The invention consists in a switch device which has a movement in either direction from a neutral or central position, and which when moved in one direction acts to throw the reverse switch and then cut out more or less of a resistance to control the action of the motor, and when moved in the opposite direction acts to throw the reverse switch to the opposite position and then cut out the resistance in the same manner. This switch is duplicated at opposite ends of a car.

452,424. Electric Synchronizing Device for Clock Hands. Albert M. Church, Chicago, Ill.

The invention relates to electric synchronizing apparatus for clocks; and its object is to provide for synchronizing or setting a large number of clocks automatically by the standard clock. When clocks are thus set, it is desirable that the second-hand should be "synchronized," as it is usually called, with the minute hand. It is also desirable that the second-hand should have a frictional engagement with the shaft upon which it is mounted.

452,429. Electric Motor. Elisha Gray, Highland Park, Ill.

The last claim follows:

"The combination, with an electric circuit including two electro magnets, a pole-changer, and a polarized relay connected to short-circuit one or the other of said magnets, according to the polarity of the current over the circuit, of armatures for said magnets, each made in two parts mounted to move to and from each other and to and from their respective magnets, and a driver acted on in reverse directions by said armatures."

452,494. Leading in Wire for Incandescent Electric Lamps. Reginald A. Fessenden, Roseville, N. J.

452,506. Electric Signal Apparatus for Fire Hose. Jacob F. Klumpp, Jr., Louisville, Ky.

452,510. Insulated Electric Conductor. James B. Williams, Oakland, Cal.

452,514. Luminous Sign. Carl Beck, Chicago, Ill.

452,515. Electric Railway-Train Signal and Recorder. Fred. H. Brown, Chicago, Ill.

The first claim is given:

"The combination of a primary electric circuit, a track-contact included in said circuit, a circuit-closer carried by a train or other moving body, a signal device included in a shunt-circuit, a resistance included in the ground connection of the primary circuit, and a battery of sufficient tension to overcome the resistance and shunt the signaling device into the primary circuit."

452,516. Joint for Electric Conductors. Edward Carroll and Thomas B. Lambert, Chicago, Ill.

452,523. Electric Insulator. Byron Jennings, San Jose, Cal.

452,542. Trolley Device for Electric Railways. David N. Cook, Salem, Mass.

452,546. Wind Apparatus for Generating Electricity and Charging Secondary Batteries. James M. Mitchell, Lawrenceville, Ga.

The invention relates to that class or type of mechanism whereby the natural powers or forces are sought to be utilized for the generation of one or more electric currents, the object being to supply electric currents having suitable energy for the operation of electric arc lamps or other devices, or, on the other hand, for incandescent lamps, or doing other work, such as operating motors, and for other purposes.

452,561. Brush Holder for Commutators. Isaac H. Bartholomew, Northford, Conn.

452,565. Glass Covered Electric Wire. William Curry, Baltimore, Md.

452,571. Electric Device for Harness. Albert B. Holson, Chicago, Ill.

452,574. Rheostat. Charles D. Jenney, Indianapolis, Ind.

452,576. Crossing for Overhead Trolley-Wires. John Kuehnle, Detroit, Mich.

452,585. Annunciator-Drop. Howard C. Shivler, Brooklyn, N. Y.

452,611. Conductor for Electric Railways. Edward W. Mitchell, Spokane Falls, Wash.

452,621. Motor Mounting of Electric Cars. Sidney H. Short, Cleveland, O.

452,622. Electric Railway Car. Sidney H. Short, Cleveland, O.

The last claim reads:

"16. The combination, with a car, of a propelling motor comprising a directly connected armature provided with a hollow shaft surrounding the car axle and mounted on journal bearings, said shaft being of sufficient diameter to allow movements transversely of the car axle and field magnets supported at points on opposite sides of the car through springs or buffers independently of the main springs of the car."

452,633. Electric Arc Lamp. Frank Buchanan, Lima, O.

Claim two is:

"In an electric lamp, the combination, with upper and lower carbon holders, of a yoke frame attached to each carbon holder, a rotating friction clutch wheel journaled upon each yoke, a pawl for turning each wheel, a lever for actuating each pawl, connections between the two levers, and means for simultaneously operating both levers to rotate the fricton clutch wheels in unison."

452,636. Telephone Transmitter. Philip Fitzsimmons, Birmingham, Ala.

452,638. Sectional Shade for Incandescent Electric Lights. Albert F. Gartner and John C. Harris, Savannah, Ga.

452,645. Insulator Holder for Electric Railways. Byron Jennings, San Jose, Cal.

452,701. Shade for Incandescent Electric Lights. Albert F. Gartner and John C. Harris, Savannah, Ga.

452,717. Electric Motor or Generator. Andrew L. Riker, New York, N. Y.

This invention relates to the construction of electric motors designed for propelling street cars and like vehicles, and has special reference to the assembling of the laminated frames or supports of the field magnets of such motors.

452,718. Bipolar Dynamo or Motor. Andrew L. Riker, New York, N. Y.

The invention relates to the construction of the continuous frames constituting the cores and pole pieces of field magnets of dynamos or motors of small size, such as are used for very light machinery.

452,725. Insulated Electric Conductor. James B. Williams, Oakland, Cal.

452,735. Electric Alarm. Charles H. Shaffer, Rockford, Ill.

452,741. Electric Railway System. David G. Weems, Baltimore, Md.

452,758. Microphone. August C. F. Muller, Berlin, Germany.

452,760. Composition of Matter for Insulating Purposes. Frederick Salathe, Jersey City, N. J.

452,765. Composition of Matter for Insulating Purposes. Frederick Salathe, Jersey City, N. J.

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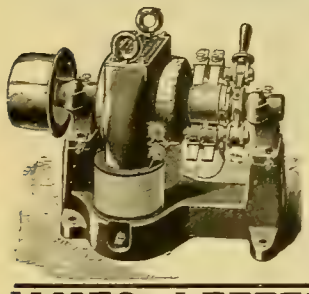

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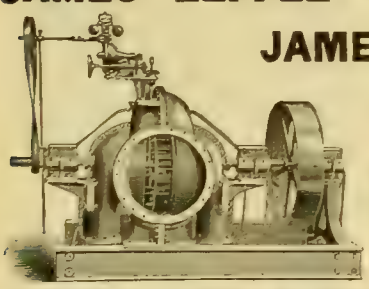

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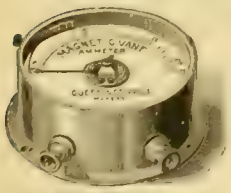

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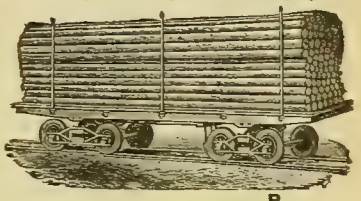

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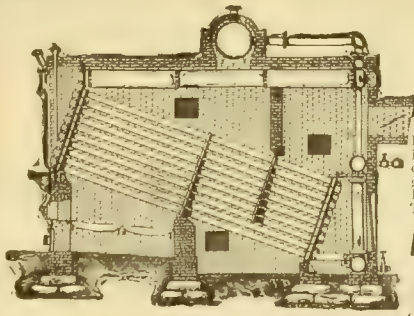

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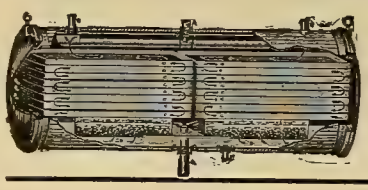

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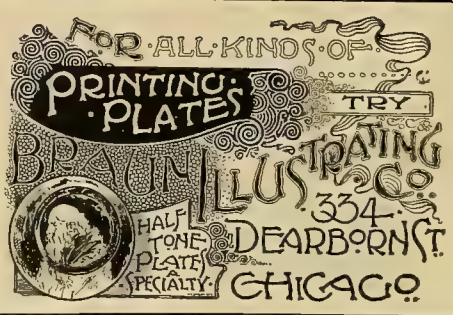

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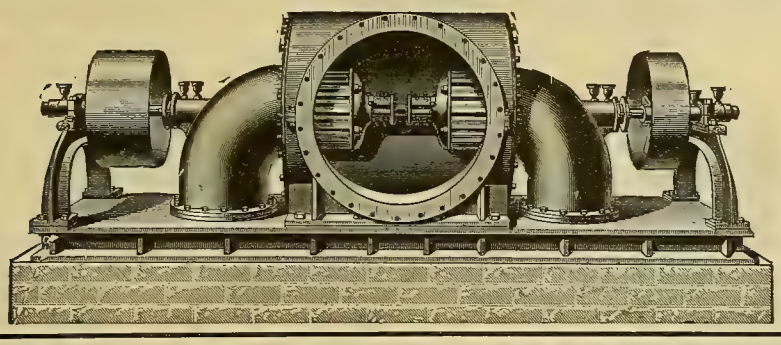

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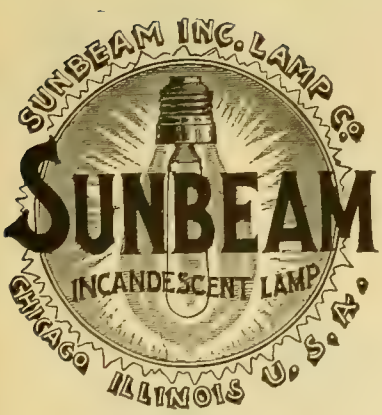

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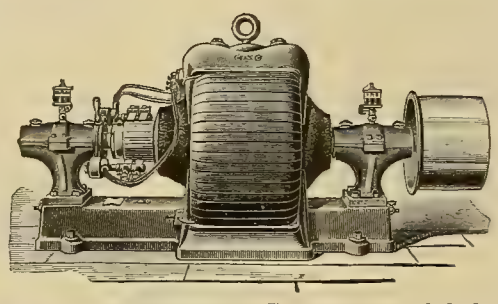

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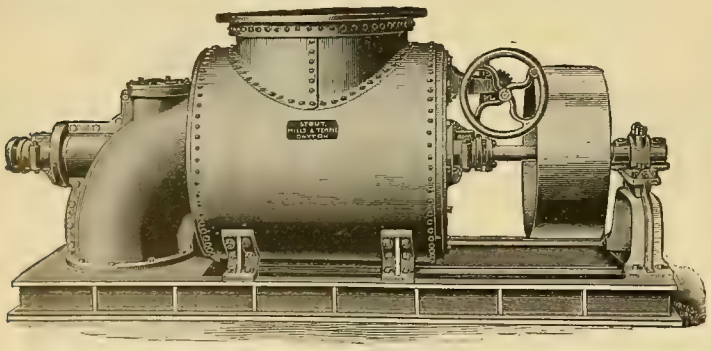

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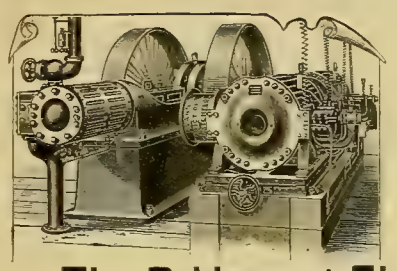
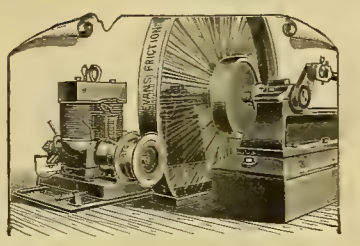
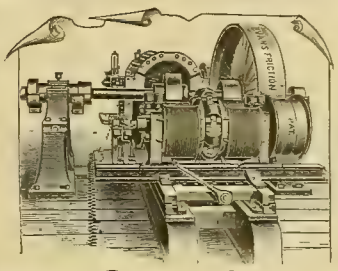
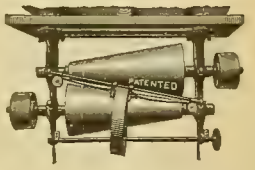

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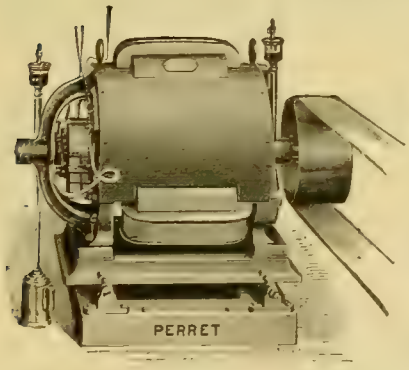

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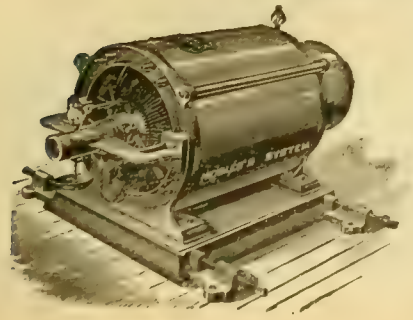

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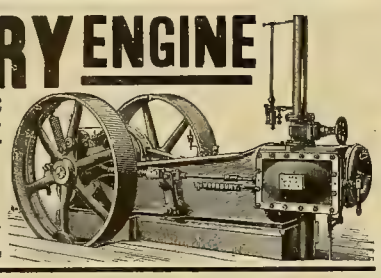

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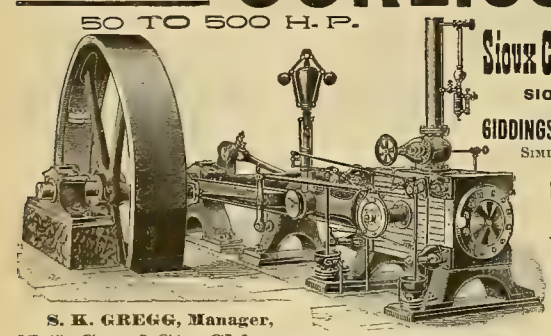

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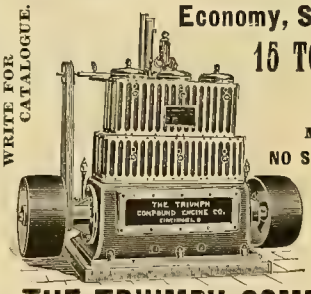

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(Signed) F. G. BEACH, Gen'l. Supt.

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CHICAGO, ILL., April 8, 1891.

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Yours truly,
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Purchasing Agent.

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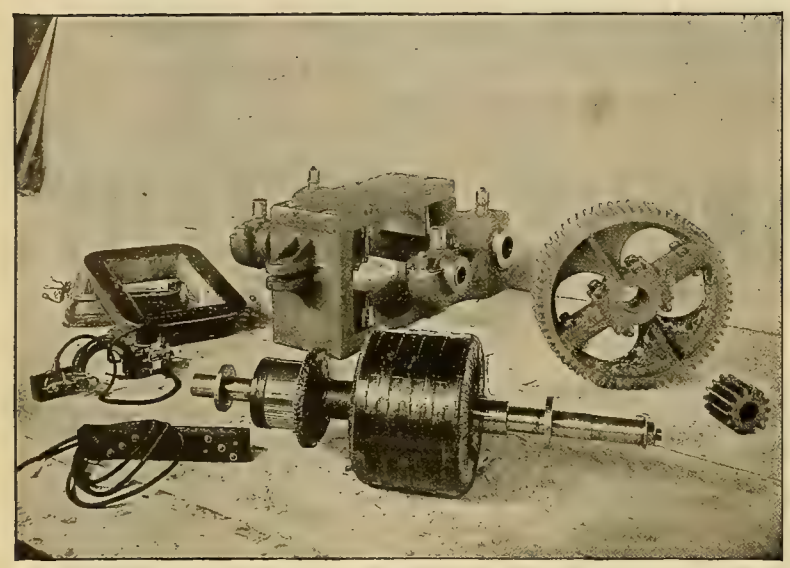
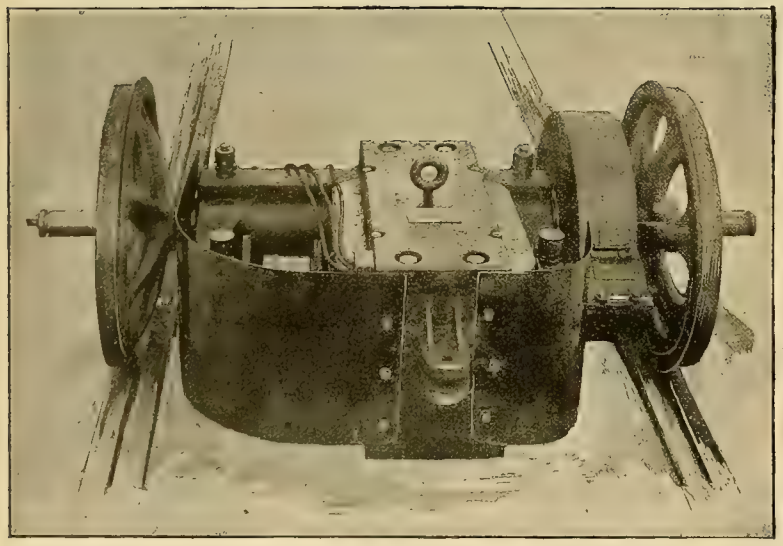
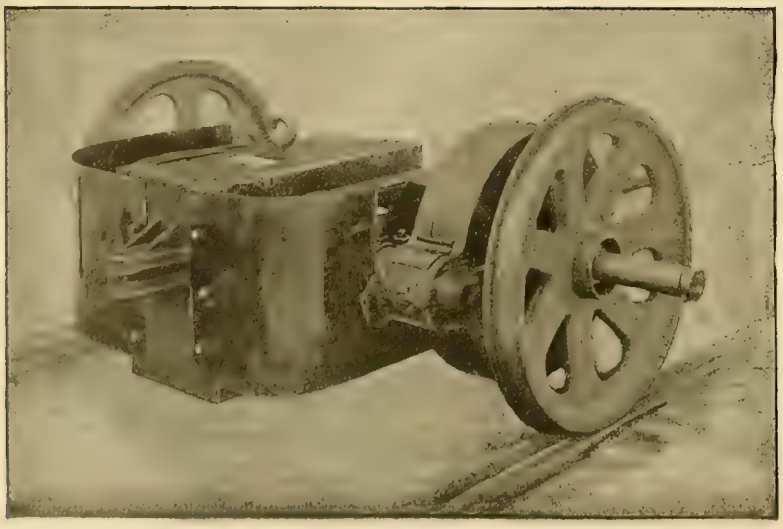
Has Revolutionized the Electrical Equipment of Street Railways.







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Reducing to a minimum the cost for repairs and absolutely eliminating the objectionable noises incident to all other systems.

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The Railway Motor, as now constructed, comprises less than a dozen parts.

The construction of the Armature avoids the possibility of a burn-out, except by malicious carelessness, and when damaged, can be readily repaired by a novice.

Don't make a mistake by contracting for Railway Equipment before seeing or understanding this marvelous machine.

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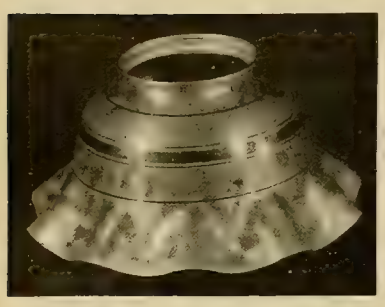

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For Practical Use, Increases the Amount of Light Two-Fold.

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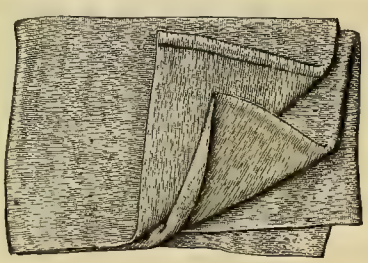

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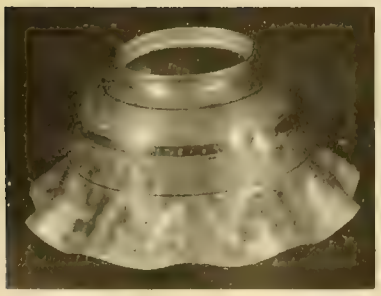

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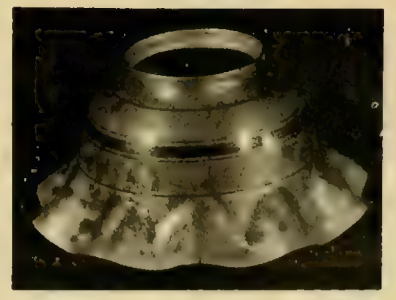

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Afford the Only Reliable and Efficient Means for

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All other devices are crude, expensive, and unsatisfactory.

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Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

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4,150	VERMONT,	2,200
12,800	TENNESSEE,	1,485
1,500	SOUTH CAROLINA,	NONE.
18,450	TOTAL,	3,685

FIVE TIMES as many of the Thomson-Houston System as of

ALL OTHERS COMBINED.

The figures referring to "total of all systems," taken from table published in August number of "Electrical Industries," for year 1890, are of undisputed accuracy.	Total of all systems.	Thomson-Houston System.	
		Number.	Percentage to total of all systems.
Vermont, - - - -	6,350	4,150	$65\frac{3}{10}$ per cent.
Tennessee, - - - -	14,285	12,800	$89\frac{1}{2}$ per cent.
South Carolina, - -	1,500	1,500	100 per cent.

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1110 Noble Street, Philadelphia, Pa.
1333 F Street, Washington, D. C.
115 North 3d Street, St. Louis, Mo.

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Accumulators.
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Brush Electric Co.

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Cowles Electric Smelting & Refining Co.
Cowles Syndicate Co.
Cleveland Aluminum Co.
Freeman, Coleman & Co.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
GreatWestern Electric Supply Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Anti-Friction Metal.
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Brush Electric Co.
Easton Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
McLaughlin, Jas.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co., The.
Fletcher & Fletcher Electric Co.
GreatWestern Electric Supply Co.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Southern Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co., The.
Holtzer-Cabot Electric Co.
Partrick & Carter Co.
Queen & Co.
Stanley & Hall.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Northwestern Elect. Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Wollensak, J. F.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.
Standard Electrical Works.
Stanley & Hall.
Star Electrix Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
(See Wire Insulated.)

Cable, Electric. (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Minneapolis St. Ry. Co.
Stephenson Co., John.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Electric Construction & Supply Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Chicago Electric Mfg. Co.
Knapp Electrical Works.
McLaughlin, Jas.
Shawhan Machine Works.
Temple, J. C.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brush Electric Co.
Chicago Electric Mfg. Co.
Edison General Electric Co.
Electrical Engineering Co.
Fort Wayne Electric Co.
Engineering Equipment Co.
Hutton, Henry.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Temple, J. C.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Roebling's Sons Co., Jno. A.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Holmes, C. H.
Monitor Electric Co.
Southern Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Automatic Switch Co.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Palste, H. T.
Partrick & Carter Co.
Southern Electrical Supply Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
Colburn & Co., I. W.
Electrical Engineering Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Howard & Co., Hiram M.
Heisler Electric Light Co.
Little & Co., F. P.
National Electric Manufacturing Co.
Schuyler Electric Co.
Shawhan Machine Works.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Specialties.
Hipwell Mfg. Co., H. H.
Northwestern Elect. Specialty Co.
Turner Brass Works.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Engineering Equipment Co.
Pearson & Co., W. B.
Pond Engineering Co.
Sioux City Engine Works.
Stearns Mfg. Co.
Triumph Compound Engine Co.
Westinghouse Machine Co.

Engravers.
Braun Illustrating Co.

Fire Alarms.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Cleverly Electrical Works.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.
Wollensak, J. F.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Cleverly Electrical Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Holmes, Booth & Haydens.
Holtzer-Cabot Electric Co.
International Okonite Co., The.
Knapp Electrical Works.
Lennon, J. M.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Stanley & Hall.
Standard Electrical Works.
Thomson-Houston ElectricCo.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.
Wollensak, J. F.

Globes and Electrical Glassware.
Baggot, E.
Great Western Electric Supply Co.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Butler Hard Rubber Co.
Central Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Empire City Electric Co.
Fletcher & Fletcher Electric Co
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Monitor Electric Co.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Paint Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Interior Conduit & Insulation Co.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Buckeye Electric Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Heisler Electric Light Co.
Hood, Wm.
Knapp Electrical Works.
Lennon, J. M.
Monitor Electric Co.
Sawyer-Man Electric Co.
Southern Electrical Supply Co.
Sunbeam Incandescent Lamp Co.

Lamps, Incandescent—Contd.
Thomson-Houston Electric Co.
Western Electric Co.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.
Partrick & Carter Co.

Mica.
Munsell & Co., Eugene.

Mining Apparatus, Electric.
Bain Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Electric Mfg. Co.
Brush Electric Co.
Baxter Electric Motor Co.
Calkins & Son J. W
Card Electric Motor & Dynamo Co.
Crocker-Wheeler Electric Motor Co.
C. & C. Electric Motor Co.
Detroit Electrical Works.
Easton Electric Co.
Edison General Electric Co.
Electrical Engineering Co.
Elektron Manufacturing Co.
Hawkeye Electric Mfg. Co.
Lennon, J. M.
Shawhan Machine Works.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Westinghouse Electric & Mfg. Co.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Packing.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Holmes, C. H.
Standard Electrical Works.
Southern Electrical Supply Co.
Western Electric Co.

Poles.
Brownlee & Co.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Holmes, C. H.
Milliken Bros.
Sterling, W. C.
Star Iron Tower Co.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Knapp Electrical Works.
Northwestern Elect. Specialty Co.
Partrick & Carter Co.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
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Separators, Steam.
Pond Engineering Co.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Western Electric Co.
Wollensak, J. F.

Speed Indicators.
Queen & Co.

Street Ry. Equipment.
Minneapolis Street Ry. Co.

Supplies, Electric Railway.
Electric Merchandise Co.
Electric Railway Specialty Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Western Electric Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Standard Electrical Works.
Western Electric Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Telephones, Non-Electric.
Bostwick & Burgess Mfg. Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co

Office Furniture.
Andrews & Co., A. H.

Transformers.
Stanley Electric Mfg. Co.

Trucks, Electric Car.
Detroit Electrical Works.
Edison General Electric Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co

Turbine Wheels.
Dayton Globe Iron Works Co.
Hunt Machine Co., Rodney.
Leffel & Co., James.
Stilwell & Bierce Mfg. Co.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.
Partrick & Carter Co.
Roebling's Sons Co., Jno. A.

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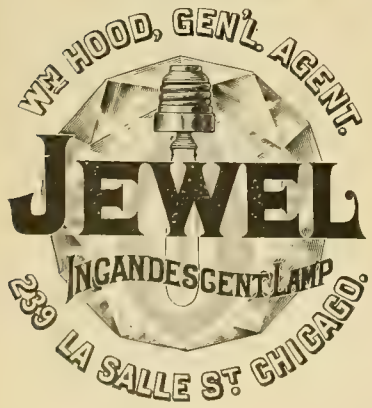
WHAT?



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Compare these weights with weights of other transformers:

5 light,	48 lbs.
10 light,	65 lbs.
20 light,	85 lbs.
30 light,	101 lbs.
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100 light,	300 lbs.

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SMALL,
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CONCENTRIC CABLES, any millage, FLEXIBLE CORDS. SILK, HEMP, COTTON, DYNAMO WIRES and CABLES, very pliable. Every variety of INCANDESCENT CORES.

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1 dozen lots,	-	-	$2.00.
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25 " "	-	-	1.40.
50 " "	-	-	1.35.
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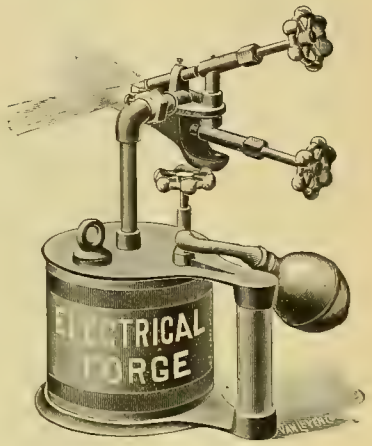
Is safe, durable, easily repaired, has a reversible burner that can be used in any position and will not blow out in a gale of wind. Can be used as a Blow-pipe Torch or a Fan-tail Heater and can be instantly changed from an intense heat to a feeble flame, or the reverse.



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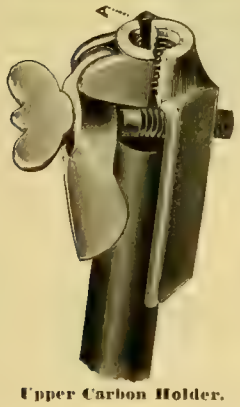
Can also be used in the highest wind. One gallon of 74° deodorized gasoline will run it all day. It is made to stand hard work.



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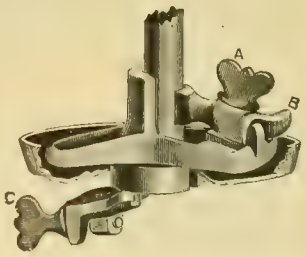
Are designed especially for Thomson-Houston and Brush lamps, and are sold at very low prices. We also have a lot of Thomson-Houston lower carbon holder rings.



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	For 16 c. p. lamps of 2.77 watts per candle and 300 hours average life.	For 16 c. p. lamps of 3.1 watts per candle and 600 hours average life.	For 16 c. p. lamps of 3.6 watts per candle and 900 hours average life.	For 16 c. p. lamps of 4 watts per candle and 1,500 hours average life.
Power	0.357 cts.	0.400 cts.	0 464 cts.	0.516 cts.
Lamp Renewals	0.146 cts.	0.073 cts.	0.049 cts.	0.029 cts.
Total cost per 16 candle lamp hour when the power to run a 16 c. p. 3.1 watt lamp costs 0.4 cts. per hour, and lamps cost 44 cts. each	0.503 cts.	0.473 cts.	0.513 cts.	0.545 cts.

N. B. The Edison Lamp has an efficiency of 3.1 watts per candle.

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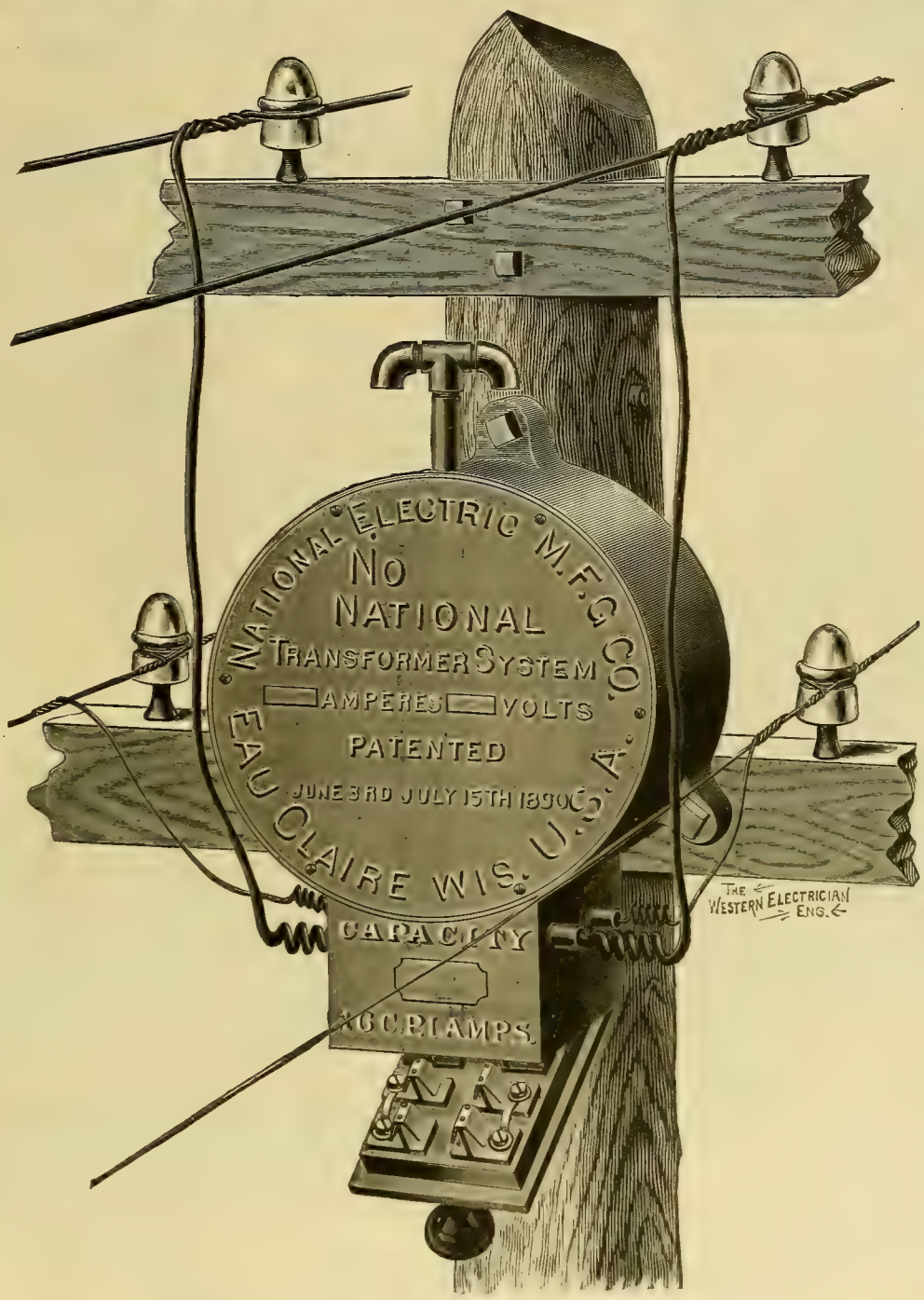

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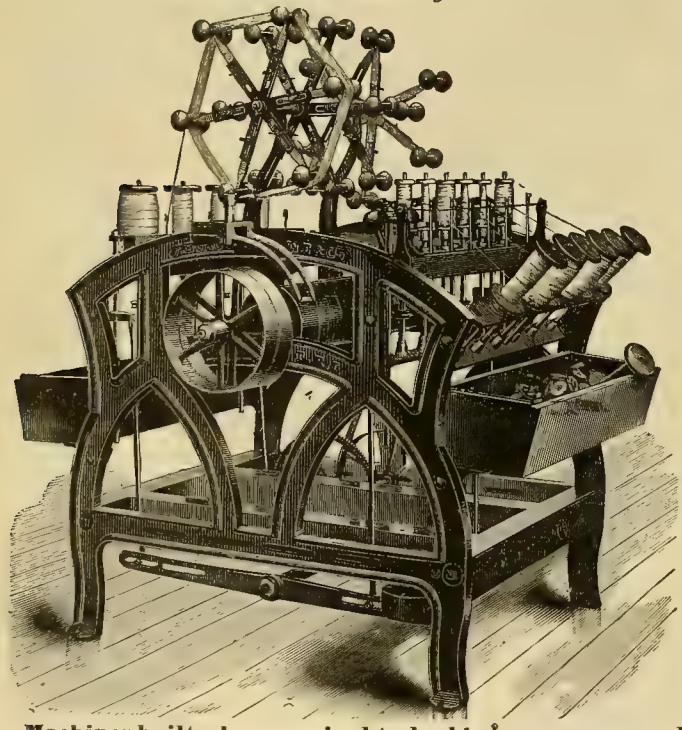

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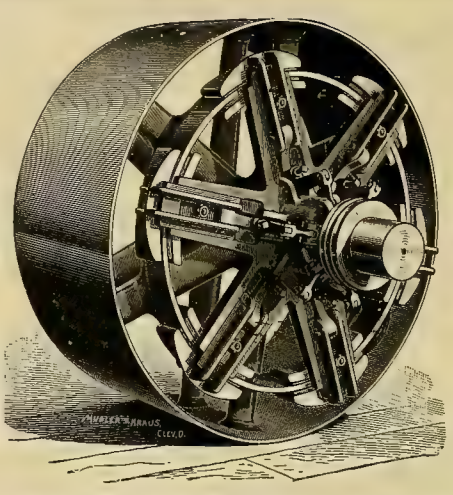

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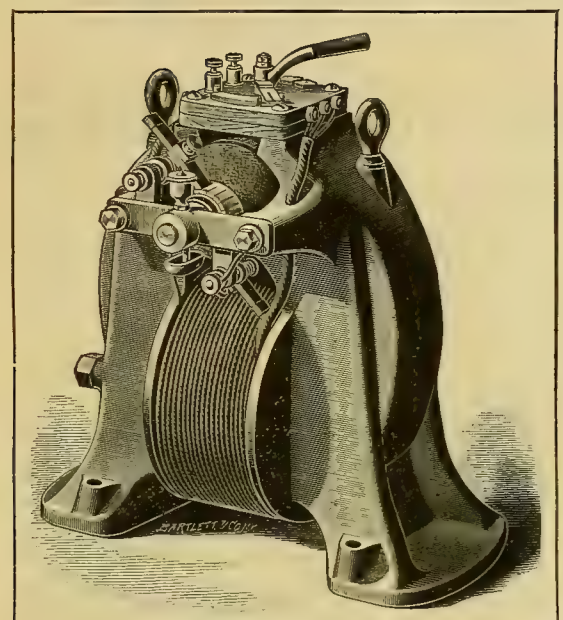

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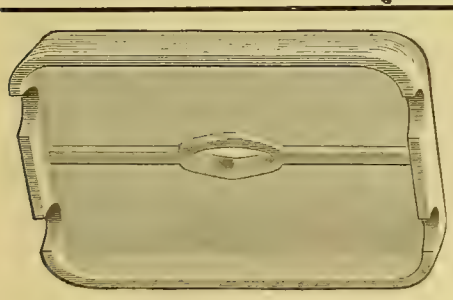

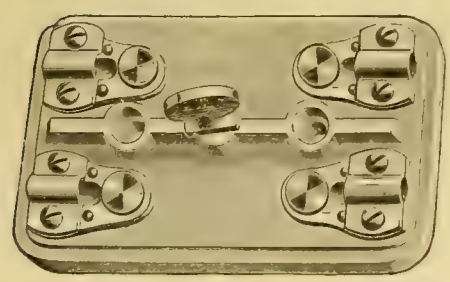

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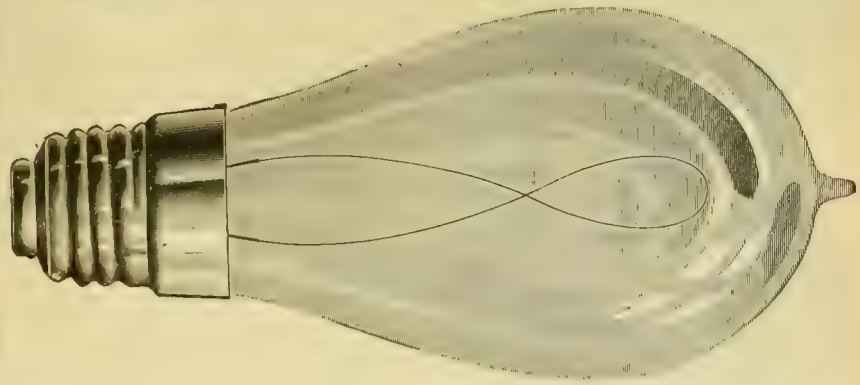

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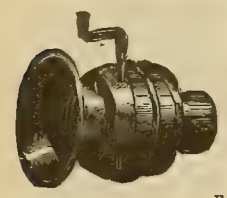

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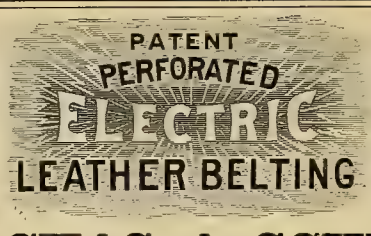

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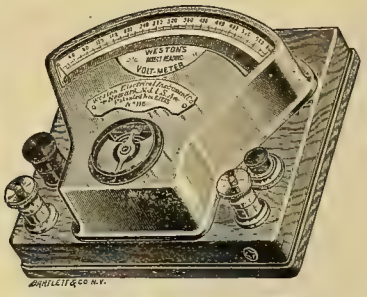

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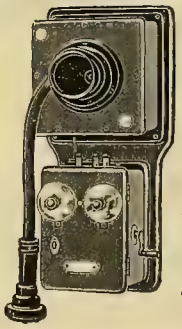

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Vol. VIII. CHICAGO, JUNE 6, 1891. No 23

Electric Welding in a Carriage Factory at Harvey, Ill.

The firm of Craver, Steele & Austin of Harvey, Ill., has recently installed in its shops one of the electric welding plants of the Thomson Electric Welding company of Lynn, Mass. The installation is now in active operation, and, in addition to the regular welding work, is furnishing current for a large number of incandescent lights.

This plant is being applied to carriage work, and the apparatus employed is one of recent design, so constructed as to handle a large variety of stock with but few adjustments. The complete plant consists of a dynamo, a switch-board furnished with the necessary indicators and converters, and the welding machine proper. The dynamo of 30,000 watts' capacity, is a six-pole machine, with an armature of the drum type. It runs at 1,000 revolutions per minute delivering a maximum primary current of 100 amperes at a constant potential of about 300 volts. The machine is self-exciting and is over-compounded to the extent of about 10 per cent. The bearings of this generator are self-oiling and require almost no care. The boxes are of gun metal so constructed that they can be removed with perfect ease. The generator and the switch-board have been placed in the engine room of the factory while the welder proper is located in the smith shop about 150 feet away. The dynamo is belted to a countershaft taking power from the 135 horse power Cooper-Corliss engine which drives the factory. Three wires extend from the dynamo to the switch-board. These leads, which are taken from the brushes bearing on the collector ring, constitute the welding and exciting circuits. In series with the exciting circuit and on the switch-board there is a single pole switch and rheostat which after the plant has been started, are adjusted and are never changed. A reaction coil placed below the board affords automatic action in the necessary compounding when the load is thrown on.

The lighting arrangements which are an important feature in the installation, were designed by the Welding company. Thomson-Houston transformers specially wound, key sockets furnished by the same company, and 16 candle power 75 volt Sawyer-Mann lamps are used.

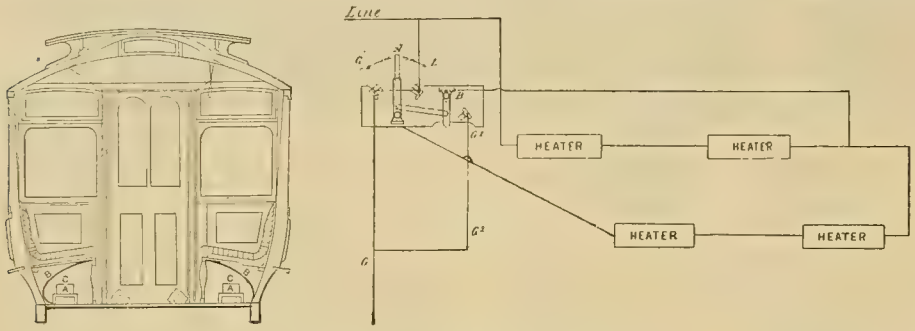
The welding machine as used by Craver, Steele, and Austin, requires for its operation two men. One man is the welder and the other is a helper. A little study of the accompanying cuts will readily show the method of operating. The axle, tire, or whatever is to be welded is placed in the two jaws which form a part of the large copper secondary of the welder, the stock being clamped in these jaws and a perfect contact thereby insured, the abutting ends are brought together by means of a pressure device, in this case operated by a man on the left, and the circuit is then closed by means of the large upright switch at the right of the machine. This switch is operated by means of a treadle in the base of the machine. The current is delivered to the primary of the transformer in the lower part of the welder, and the secondary current developed in the large copper secondary passes into the stock to be welded. As the current heats the metal at the junction to the welding temperature, the pressure follows up the softening surface until a complete union is effected, and as the heat is first developed within the parts to be welded, the interior of the joint is as efficiently united as the visible exterior. A slight upset or burr at the weld is formed ; but this is quickly dressed down in the same heat. A small stream of water flowing constantly through the clamps of the welder keeps all parts perfectly cool. The water is taken from the mains in the shop. This welder which will accommodate stock from one-half inch to two inches in diameter, will be used in welding axles, tires, dash rods, tumbling rods, and in fact will do all welding common in carriage work. The installation at Harvey was made under the supervision of W. S. Gorton. For the description of the plant the Western Electrician is indebted to Philip Harvey, the western representative of the Thomson Electric Welding company.

ELECTRIC WELDING IN A CARRIAGE FACTORY AT HARVEY, ILL.—THE WELDER.

Englishmen are beginning to light their theaters by electricity. London *Industries* announces that the new theater at Southport will be illuminated by 220 incandescent lamps.

Burton Electric Heater.

Much attention has been given the subject of electric heaters, especially since the introduction of electricity for operating and illuminating street cars. It will be readily seen that the application of the system could not be made under more favorable circumstances. Considerable progress has been made in this direction. In the accompanying cuts is illustrated the Burton system of electric heating. The device is the invention of Dr. W. Leigh Burton, and was first shown in 1887. Later several improvements were made in the method of electrically connecting the heaters. The apparatus used and the method of wiring will be readily understood by reference to the accompanying diagrams. Fig 1 shows the iron casing with a corrugated covering to facilitate the radiation of the heat. This casing contains the German silver wire stretched back and forth across the case and embedded in fire clay. In wiring the ordinary street car, two such heaters are usually placed on each side, under the seats, as shown in Figs. 2 and 3. The wiring is very easily done. Connection is made to the trolley wire in one corner of the car, and the current is conveyed through the heaters under one seat and carried to the other side to a ground connection on the truck. The method of wiring adopted by the company is shown in Fig. 4, and for street car service the electrical resistance of the heaters is so adjusted that on a 450 volt circuit three amperes of current are used. When, therefore, the handle of the switch *A* is turned on *L* (shunt from line connection) and *B* closed, the heaters are thrown in series of two for a short time only, causing the use of six amperes of current in each set. When a sufficiently high temperature has been attained in these, which will be in fifteen or twenty minutes, the handle *A* is turned on *G* (ground connection), and *B* opened. This causes them to be thrown in series of four, when the heat will be maintained in them for a long time without being appreciably lowered, with the use of only three amperes of current.



FIGS. 3 AND 4. BURTON ELECTRIC HEATER.

The process of warming the cars is supposed to take place in the morning before the car leaves the shed, when there is no other use for the current. The normal use of the current required, however, being only three amperes, the cost should be calculated on that basis. It is claimed that it is fully as economical, and even more so when service and contingent expenses are considered, as the ordinary coal stove. Lieut. S. Dana Greene, the consulting electrician for the Burton company, estimates that the cost is less than 10 cents per day for each car, and in some cases this estimate has been found too great. The patrons of roads using electric heaters are enthusiastic in their praise, and to any one familiar with the dirty and gaseous condition of the average coal heated car, the absolute cleanliness and absence of odors, together with the even temperature of a car electrically heated, are a revelation.

The electric heater would find its warmest welcome, however, as a successor to that "deadly car stove" to whose account so many tragedies must be placed. Here the absolute safety of the electric heater should commend it, even though dividends were lessened somewhat by its use. By the employment of dynamos and storage batteries now carried on trains for incandescent lighting, the heater could be used and the increased safety and comfort would more than compensate for any expense involved.

The John Scott legacy medal has been awarded the inventor for his electric heater, on the recommendation of the Franklin Institute of Philadelphia. The heaters are manufactured by the Burton Electric company, Richmond, Va. The Electric Merchandise company of Chicago is selling agent.

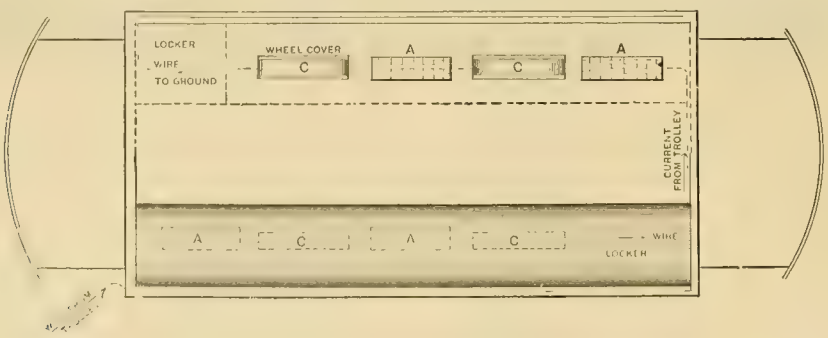


FIG. 2. BURTON ELECTRIC HEATER.

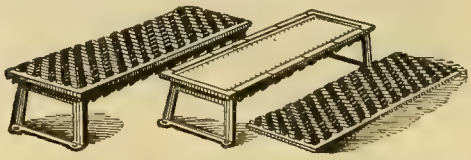
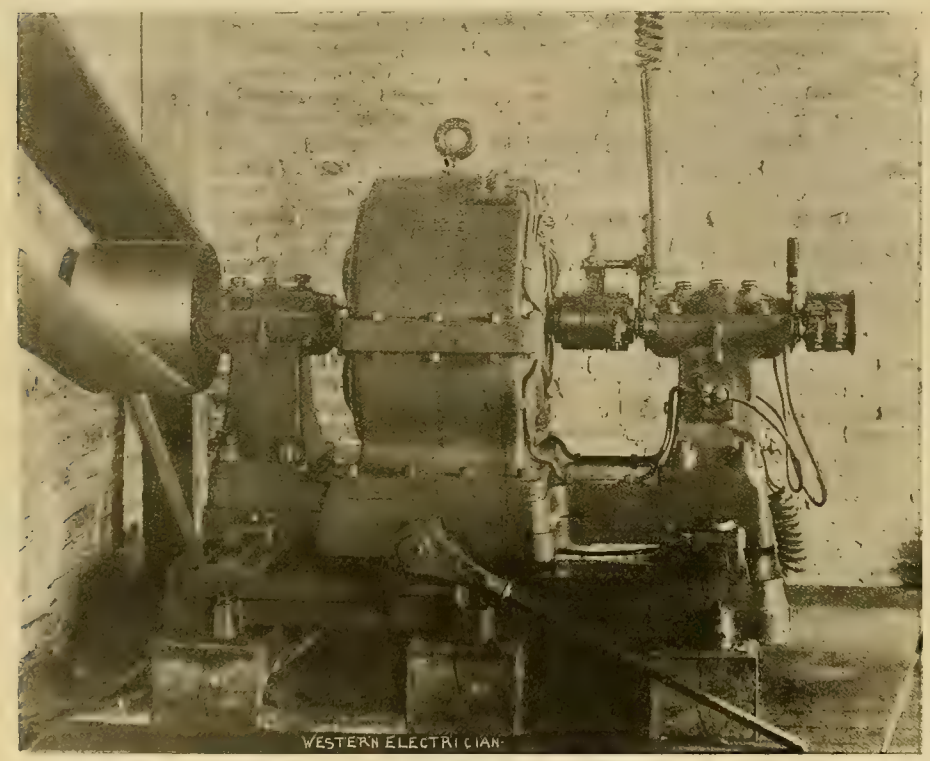
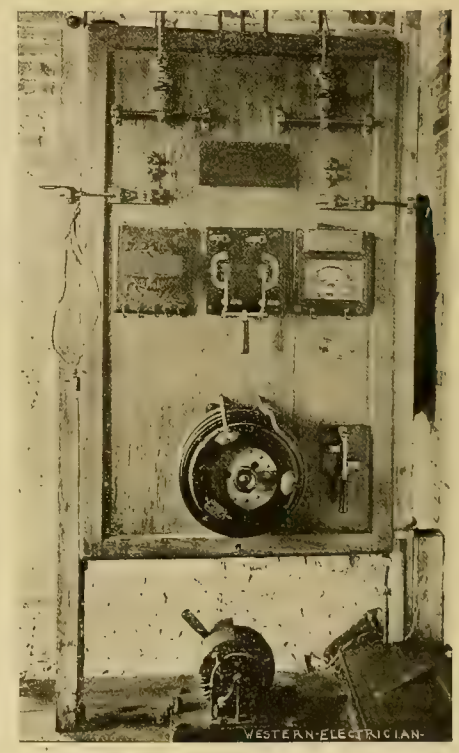


FIG. 1. BURTON ELECTRIC HEATER.





ELECTRIC WELDING IN A CARRIAGE FACTORY —THE GENERATOR AND SWITCH BOARD.

Crystal Palace Electrical Exhibition.

An electrical exhibition, on the same lines as the one which proved such a brilliant success in 1881, will be opened at the Crystal Palace in November, 1891, and be continued for several months, according to the English papers. Applications for space must be made, not later than September 5, 1891. R. Applegarth has been appointed assistant engineer to the exhibition.

Electric Mining Machines.

The introduction of electricity in the operation of mining machinery has proved a great advancement in mining work and has at the same time opened a wide field of operation for electric companies. To fully realize the importance of this department it is but necessary to consider the numerous applications of electricity in this line which have already been successfully made. Elmer A. Sperry's invention of a coal mining machine marked the commencement of a Chicago industry which has already assumed substantial proportions.

In the accompanying illustration is shown the testing room and part of the machine shops of the new factory of the Sperry Electric Mining Machine company at Thirty-ninth street and Stewart avenue.

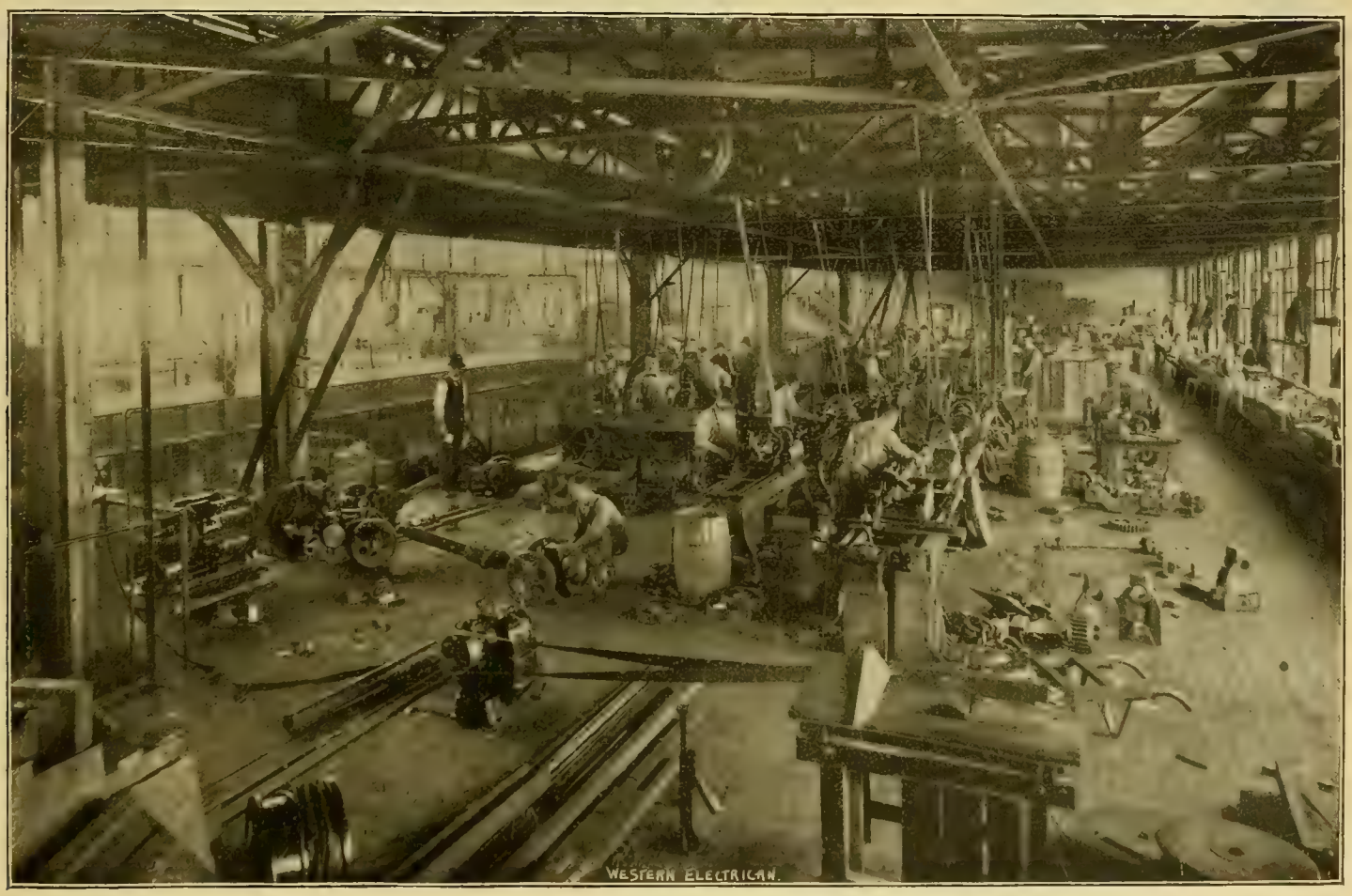
The company's first machine was built for the Chicago, Wilmington & Vermillion Coal company. This machine was exhibited at the convention of the National Electric Light association, Chicago, in 1889, and attracted much attention. It was afterward sent to Paris and exhibited at the exposition, where it again attracted much attention. This machine has already been fully described and illustrated in the WESTERN ELECTRICIAN.

In April of the same year the Sperry Electric Mining Machine company was organized with A. L. Sweet, president; Herbert E. Goodman, secretary and treasurer, and Elmer A. Sperry, engineer, and a number of machines of the same pattern as those exhibited in Paris were built and installed in Indiana and Illinois coal mines.

The machines, however, soon proved that, while a mining machine might run satisfactorily on a factory floor, its performance in a mine might be very different. So during the next year many improvements were made, mainly in reducing the number of small parts in the machines, and making others heavier. The point of capacity was easily reached, but it was not until the summer of 1889 that a plant of four machines was in successful operation with the repair bill reduced to a minimum.

In the meantime the company had begun to build mine haulage and pumping apparatus, and it was realized that the concern was to carry on a manufacturing business of much larger proportions than was at first supposed, and one that would require more time from its president than he was able to give. On this account a transfer of his interest to W. D. Ewart, president of the Link Belt Machinery company, Chicago, took place, and at the same time A. D. Dana, treasurer of the Link Belt company, became treasurer.

The company has building hauling, pumping and mining machine plants in several states, and has recently enlarged its facilities for manufacturing. The accompanying cut shows the testing room and a portion of the machine shop. The building was constructed by the Berlin Iron Bridge company.



ELECTRIC MINING MACHINES.

The Chicago Electric Club.

The Chicago Electric club has resumed its restaurant service greatly to the satisfaction of the club members. Last week regular service was resumed, a business lunch being served between 12 and 2 every day, and special dishes to order at any time before 11 P. M. This feature of the club was well patronized, especially the business lunch, and as each day brings new acquisitions to the ranks the outlook is exceedingly promising.

Much of the old interest in club matters has been revived, and it is mainly due to the new feature of the club. The attendance in the evenings has been greatly increased since the restaurant was opened.

A general house cleaning was deemed advisable while the arrangements for the restaurant service were in progress, and when the formal opening of the new department was held everything about the rooms looked bright and inviting. The impression, therefore, that the members received was highly favorable, and the club begins its career under the present order with the best wishes and hearty co-operation of the entire membership. While the members were congratulating themselves upon the improvements that had been made they did not forget that they owed much to the indefatigable efforts of W. B. Pearson, chairman of the committee having in charge the introduction of the restaurant service. Mr. Pearson certainly deserves all the praise that has been bestowed upon his well directed efforts. Thus far the arrangements that he has made have secured the most satisfactory service the club has ever enjoyed.

Collecting Race News under Difficulties.

There is an interesting controversy in progress between the managers of several eastern race tracks and the telegraph companies. A press dispatch from New York says: President Dwyer of the Gravesend course undertook to keep the telegraph companies from furnishing reports of the races, and in order to do this closed the gates immediately after racing began. No one was permitted to enter or leave the grounds during the progress of the races. Thursday afternoon the Western Union Telegraph company endeavored to get the news for the pool rooms outside the gates of the track. Several men taken into custody while attempting to pass information across the line proved to be operators in the employment of the Western Union, thirty men having been sent to the track for the purpose of obtaining the desired information. One man was arrested for throwing wooden balls such as are used on cash railways over the fence. One of the balls was opened and found to contain the betting, jockeys, starters and other information for the pool rooms. Thereafter every man found throwing the balls over the fence or catching them outside, was arrested. The operators were taken to the Gravesend jail, but, after being in custody an hour or two and nobody appearing to make a complaint, they were released. The Western Union Telegraph company has run wires into the hotel overlooking the track, and so far has managed to obtain the news for its patrons.

Phosphorus is now manufactured at Wolverhampton, England, by the aid of electricity. The process consists in decomposing the mixture of phosphoric acid, or acid phosphates and carbon, by the heat of an electric arc imbedded in the mass, and the inventors urge that the local application of heat in this form is more economical than the heating of large retorts containing the mixture in the ordinary process.

Transformer Sub-Station Regulating Mechanism.

In the accompanying cut, Fig. 1, is illustated a transformer sub-station regulating apparatus designed by Thos. Tomlinson, chief engineer of Gordon & Co., of England.

The requirements of a practical automatic controlling apparatus for transformer sub-sta-

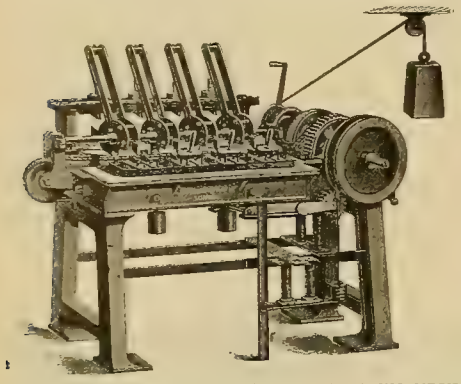


FIG. 1. TRANSFORMER SUB-STATION REGULATING MECHANISM.

tions are, according to Mr. Tomlinson, as follows: First, there must be used mechanical and not mercury contacts; second, the device must be able to break circuits carrying the heaviest currents without any sparking whatever; third, if any one of the switches accidentally becomes heated it must at once be short circuited and thrown out of action; fourth, if any accident or breakdown whatever occurs to the apparatus, every transformer must at once be put into circuit. This condition is absolutely essential, and is the most important feature of the Tomlinson apparatus.

If a sub-station controller fails while taking transformers out of circuit, no harm is done beyond a waste of coal, but if a failure were to occur when putting them into circuit it would probably cause a fire. The Tomlinson apparatus is intended to entirely guard against this source of failure.

Four sets of switches are provided, and the transformers are arranged in five groups. One group is permanently connected to the mains and one more is connected through each set of switches respectively. The transformers are grouped as shown in Fig. 2.

If one transformer is permanently connected to the mains, then one would be connected to the first switch, two to the second, four to the third and eight to the fourth, so that the putting in of each switch doubles the number of transformers in circuit.

The switches are arranged to break the primary and secondary circuit simultaneously. It is claimed that the extra currents produced being in opposite directions, all sparking is prevented. With a load of 1,500 lamps on a single switch no spark whatever is visible. The switches are thrown over by a sliding carriage in the form of a double wedge, which runs backward and forward along the bed-plate of the machine, and, as it passes each switch throws, over a tumbling lever, which strikes the switch suddenly in or out of contact. This carriage is moved by an endless chain, actuated by two weights, which are released respectively by two electro-magnets. The large weight which takes transformers out of circuit has to be wound up once a week. If any failure whatever of the large driving weight occurs, or if the attendant forgets to wind it up, a small weight is always ready to put the whole of the transformers into circuit, and must do this before the apparatus become inoperative.

The wheels seen in the illustration are in gear with each other, through the pinions, and the whole system is kept at rest by the brake seen at the far side of the machine. When a current is sent through the lower magnet this brake is released and the large weight falls, turns the spindle, and through the cogwheels draws the carrier back and takes switches out. At the same time it winds up the small weight, leaving it ready for putting the switches in again at any time. In case any switch should get hot, it would be short-circuited by the cross-pieces seen in Fig. 1 and shown in section in Fig 3.

These cross-pieces consist of hollow brass boxes mounted on an insulating frame, each box being electrically connected to a rod projecting inside the other box. Each box is lined with paraffine wax and filled with mercury. In case of heating, the paraffine melts and floats to the top of the mercury, which establishes a contact, and puts the switches out of action, and puts transformers into circuit.

The method of actuating the apparatus is seen in Fig. 2. A double relay is provided, placed in the secondary circuit of the fixed transformers. As soon as the current exceeds full load a contact is made, and a small current is sent through one of the magnets of the apparatus along a wire to the central station, where it passes through a choking coil and a bell. On the bell ringing, the attendant knows that more transformers must be put in, and he puts down a switch, which short-circuits the choking coil and bell, and allows a sufficient current to pass to actuate the magnet and put a sufficient number of switches in. If the attendant should inadvertently hold down his contact-key too long, the mistake will be corrected by the apparatus, as the circuit will break at the relay, and the machinery will cease to act. The magnet for taking out transformers is actuated in a precisely similar manner by the other part of the relay, which acts when the current in the fixed transformers falls to less than half load.

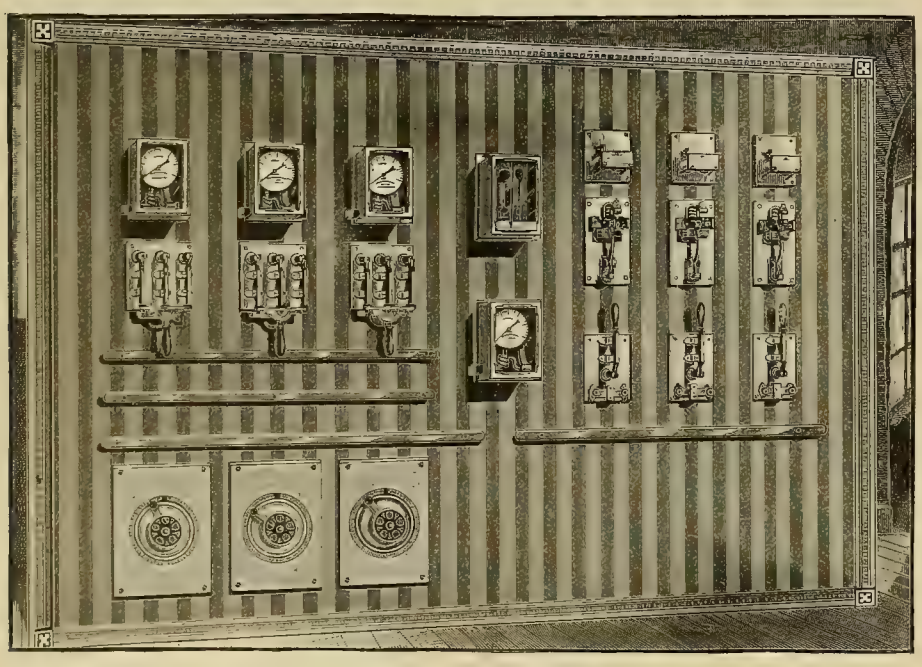


FIG. 3. WESTINGHOUSE MULTIPOLAR GENERATORS—SWITCH-BOARD.

In order to test this apparatus a plant of 1,950 8 candle power lights' capacity was connected to transformers. The plant was first run, it is stated, for twenty-four hours with the transformers connected in the ordinary manner, and then for twenty-four hours with them connected through the Tomlinson regulator, and coal and water were measured throughout the experiments. A preliminary experiment was made to find the coal used in running the engine, countershafting and dynamo light, and this quantity was deducted. The electrical load was varied according to the ordinary requirements of the London stations (what is known as a 12.2 load factor being employed). The net result of the experiment was that with the new apparatus 12¼ cwts. of coal were used in the twenty-four hours, and without it 16½ cwts., showing a saving of 26½ per cent. of the coal. From this Gordon & Co. calculate that the saving amounts to 89 pounds of coal, or in money to about 25 cents per lamp per year.

The cuts were taken from the London *Electrician.*

Electricity Substituted for the Cable.

Advocates of electric street railroads will note with satisfaction the substitution of electricity for the cable on one of the most important routes in St. Louis.

Theo. P. Bailey, manager of the railway department of the Thomson Houston Electric company's Chicago office, reports the sale last week of the electrical equipment for 45 cars, including ten generators of 100 horse power each, to the St. Louis & Suburban Railway company, St. Louis, Mo. Mr. Bailey is highly elated over this contract, as it is a verification of the prediction made by him in the paper which he read

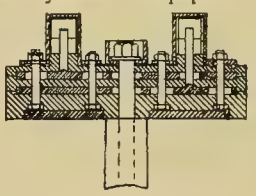


FIG. 3. TRANSFORMER SUB-STATION REGULATING MECHANISM.

before the Chicago Electric club in November last, relating to the displacement of cable equipments and the substitution of electricity. The St. Louis & Suburban road has nineteen miles of track, the power station being located so that there will be thirteen miles of track on one side of the station and seven miles on the other side. When, two years ago, it was stated that electricity would take the place of cable roads in cities where overhead privileges could be secured, and that electricity would supersede the steam dummy on suburban lines, it was thought that the assertion was merely the outburst of an over-enthusiastic advocate of electricity. The cable system on one road, however, at Grand Rapids, Mich., has been abandoned,

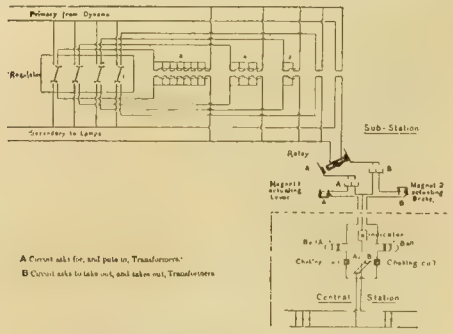


FIG. 2. TRANSFORMER SUB-STATION REGULATING MECHANISM.

and electricity has taken its place. Another and similar case is now reported, and a third, it is said, is soon to follow. Omaha and Denver have both abandoned branch cable lines, and are now operating electric cars instead.

In San Francisco the city authorities are contemplating the advisability of requesting the California Electric Light company to replace all the large 16,000 candle power light masts with smaller ones of 2,000 candle power each.

The Westinghouse Multipolar Generators.

The demand for large slow-running generators for street car work has been so great of late that the Westinghouse Electric & Manufacturing company has introduced a specially designed compound-wound multipolar generator illustrated in the cuts. This machine is at present built in three sizes, 125, 250 and 500 horse power.

It will be seen that in general design these generators resemble the Westinghouse alternating current dynamos. There is the same cylindrical yoke parting along a horizontal plane through the shaft, and the same arrangement of inwardly pointing pole pieces, but with a much smaller number of the latter.

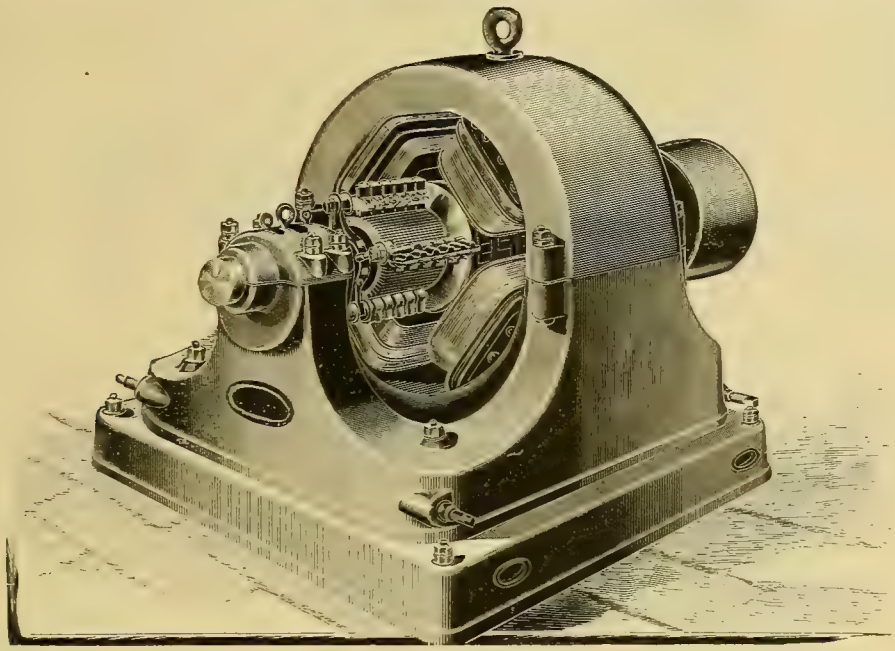


FIG. 1. WESTINGHOUSE MULTIPOLAR GENERATORS.

Fig. 1 illustrates the appearance of the 125, and 250 horse power machines, both of which have four pole pieces, while Fig. 2 shows the 500 horse power generator with six poles. In the latter machine the shaft has a bearing outside the pulley, which relieves it in a large degree from the bending strain, and adds much to the rigidity of the armature.

The pole pieces are built up of thin sheet iron plates, bolted together and cast into the cylindrical yoke. The shunt and series coils are wound side by side upon metal bobbins, which are then slipped over the pole pieces and held in place by bolts. The insulation of these coils as well as that of the armature is of ample thickness and of superior quality. The bearings are self-oiling as well as self-aligning, and a great amount of bearing surface is obtained, owing to the length and large diameter of the journals. The armature is of the Gramme ring type. An efficiency of 90 to 96 per cent. is claimed for the machine.

The generators are wound for 500 volts, but they can be worked up to 550 or even 600 volts with the same armature speed by throwing resistance out of the shunt circuit with the hand regulator.

The number of sets of brushes corresponds to the number of pole pieces, and the alternate ones, being of the same polarity, are connected. Each individual brush has its own spring, by means of which its pressure on the commutator may be adjusted, and any one may be removed without disturbing the others.

The dynamos are reversible, and may be run in either direction.

Fig. 3 represents a view of a switch board equipped with Westinghouse electric railroad appliances, some of which, including the circuit breaker and lightning arrester, have already been described in the WESTERN ELECTRICIAN. This board accommodates three generators and three feeders.

It is proposed to establish an electric lighting plant at the State Industrial School at Rochester, N. Y.

Electrical Department, World's Fair.

The Department of Electricity installed itself in its new quarters at 506 and 508 Rand-McNally building last week. The two offices are pleasantly furnished, and, when the improvements have been completed, will present an attractive appearance. The general entrance will be at 506. Here Secretary Hornsby has his desk and receives callers. Chief Barrett's private office will be in room 508, and it is probable that the secretary will ultimately occupy this room too, leaving the outer office for a reception room. It is expected that a stenographer will soon be employed, and it will not be long before an assistant electrician will be needed. The number of applications for space, which was very sensibly diminished during the controversy over the electrical building, is increasing again. Among the recent applicants are the Eureka Electric company of New York and the Sperry Electric company of Chicago. The former company put in a model application, including a diagram showing exactly the space wanted and the location of every piece of machinery, switch-board and show-case.

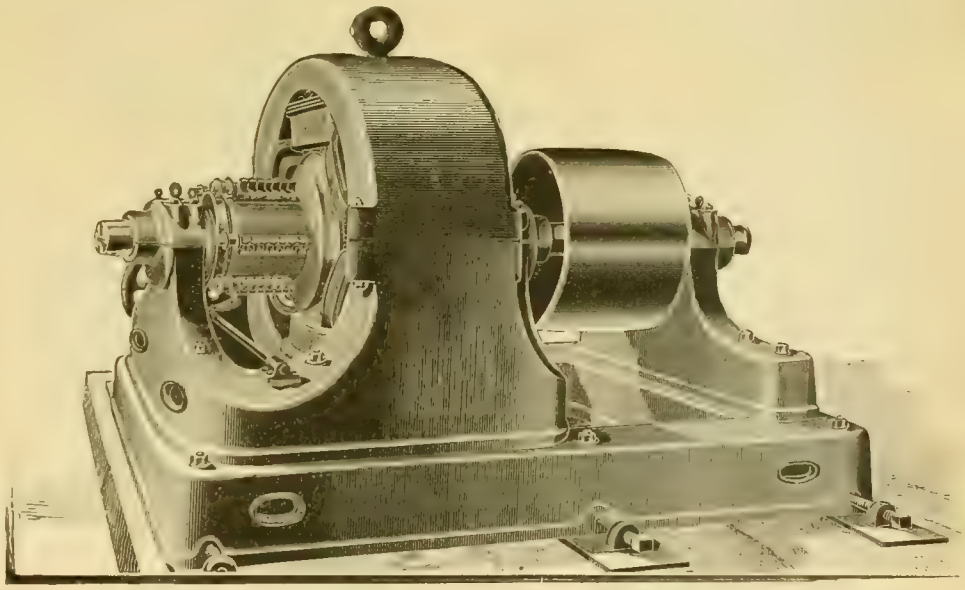


FIG 2. WESTINGHOUSE MULTIPOLAR GENERATORS.

Considerable attention is being devoted by the departments of electricity and construction to the temporary lighting arrangements at Jackson Park. It is necessary to provide light to enable the workmen to continue their operations at night, and Frederick Sargent, consulting electrical engineer of the construction department, is working out the details of the scheme. It has not been thought advisable to erect a temporary plant at the park, unless it should prove more economical, and bids for furnishing the necessary current and lamps have been solicited from the three nearest central stations. These are the Hyde Park Thomson-Houston station, the Hyde Park Electric Light company and the Sperry station at Grand Crossing. Arc lights will be used—only a few at first, although it is expected that ultimately about 200 lamps will be needed. Arrangements will be made so that the number can be increased from time to time, as desired.

Alluding to the proposed plan of having the power house for the electrical building in or near the "machinery annex," the power being transmitted by electricity, the *Electrical Engineer* of New York says: "At first sight it might appear that the main portion of the electrical energy would be required in the electrical building, but a moment's thought will show that this, however, is not the case, the proportion of power required for the exhibits being small in comparison with that to be distributed all over the exhibition and grounds for lighting, power and traction purposes. For this reason, the amount of copper in the conductors connecting the machinery annex and the electrical building will not be abnormally excessive, although, of course, the extra expense would not have been entailed had the entire display been under one roof. Strenuous efforts have been made from the outset to prevent a divided exhibit, and this newly suggested arrangement, should it be adopted, will practically make the exhibit a twin one, the generating plant in the machinery annex being, of course, considered as a part of the electric exhibit."

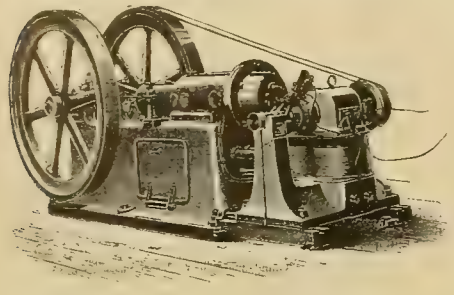
As stated in the WESTERN ELECTRICIAN last week, it is quite likely that the plans for the space heretofore designated as "the loop" may be greatly altered, and it is possible that there will be no railroad tracks at all in that part of the grounds. Should this prove to be the case, there would be no difficulty in procuring space for a power house for the electrical building, providing its site and that of the mining building were exchanged, which ought to be easily arranged.

The New York *World* recently contained an exhaustive article on the World's Fair. Among other portraits presented was one of Professor Barrett. There was also a long description of the electrical building—taken from the WESTERN ELECTRICIAN, by the way, without credit—introduced by the statement that "Prof. Barret, chief of the Department of Electricity, believes that, as planned, the building is much too small to properly accommodate the very extensive electrical exhibit which it is desired to make. In this view he is indorsed by nearly every electrical publication and electrician who has given attention to the subject. Accordingly Chief Barrett, with their earnest support, is asking that a change be made in the plans, and

that the large area within the railway loop be set aside for the electrical building."

In an article on "Night Exposition Views" the *Chicago Tribune* says:

Electricity and its manifestations are not to be confined to one or more buildings, but the 600 or 700 acres of Jackson Park, the Midway Plaisance and a portion of Washington Park are to be one grand display of electricity. By the Committee on Grounds and Buildings and the Con-



ELECTRIC LIGHT FROM OIL.

struction Department electricity is considered the most distinguishing development of the century, and the entire World's Fair site is to be utilized for its proper display. One of the novel effects contemplated is to be secured by the use of powerful search lights, which will be so employed as to light up certain portions of the grounds for specified periods and give panoramic glimpses of the buildings, grounds and lagoons. The administration building, with its gilded dome rising nearly 300 feet high in the center of a spacious plaza 700 feet square, will be one of the central points for the radiation of powerful electric light. From the lofty dome of the administration building will be shot a constantly broadening band of light northwest over the lagoon, striking the horticultural and women's buildings. This is to be a view of several minutes' duration, during which the "golden door" of the transportation building, the water lilies and marble corridors of horticultural hall and the aerial gardens of the women's building will be flooded with light. On the right of the band of light will be seen glimpses of the wooded island and aquatic plants. Another and perhaps more beautiful view will be along the line of light extending from the casino, 1,500 feet out in the lake, to the administration building. In this stream of illumination will appear all the novel craft sailing about in the outer harbor. Along the broad basin, 300 feet wide, the light will speed to the east front of the administration building and illuminate the outline of its Grecian architecture. These are but bits of the general effect. The waters of the outer harbor, the basin, the canal, the lagoons, will all be lighted by the soft, incandescent glow of electric lamps. Along the borders of the waterways, amid the foliage, will be concealed electric lights.

The scheme also contemplates electric lights for Grand and Drexel boulevards.

The Westinghouse Electric & Manufacturing company of Pittsburg has expressed its determination to make an extensive exhibit.

Commenting on the result of the fight for a larger building and a united exhibit the *Electrical World* says:

It is unfortunately reported from Chicago that the plans for a united electrical exhibit have been frustrated in spite of the earnest efforts of Mr. J. P. Barrett to consolidate all the electrical displays under one roof. As it is, the exhibit will be in two portions some 1,500 feet apart. The reason for this unfortunate arrangement may be sought in the inner consciousness of the Construction Department and its architects. The question of inward fitness for the purposes designed seems one that seldom or never enters into the understanding or the calculations of an architect. If a splendid exterior and harmonious outward proportions can reflect luster on his artistic skill, any purposes for which the building might possibly be employed seem to be completely forgotten. The buildings were laid out in dismal ignorance or utter unconcern of the real needs of the various departments for whose uses said buildings were intended; and, once planned, the symmetry of the whole must, forsooth, be preserved, whatever the effect on the exhibits supposed by the vulgar populace to be a somewhat interesting part of the World's Columbian Exposition. It is hard on the electrical section; but the majesty of art has perhaps been preserved against the envious hand of practical common sense.

The *Electrical Review* adds the following to the general complaint:

Electrical men in Chicago are still battling with the directors of the World's Fair for proper treatment for the electrical exhibit. So far the odds seem to be in favor of the original and defective plans being persisted in, despite the protests of electrical men throughout the country. Not only the electrical press generally but many of the daily newspapers of Chicago unite in condemning the obstinate attitude of the directors of the fair. If their policy is carried out the electrical exhibit will disappoint the expectations of a very large section of the community, but at any rate it will be perfectly clear that the responsibility for any failure will rest with the directors of the exhibition, and with them alone.

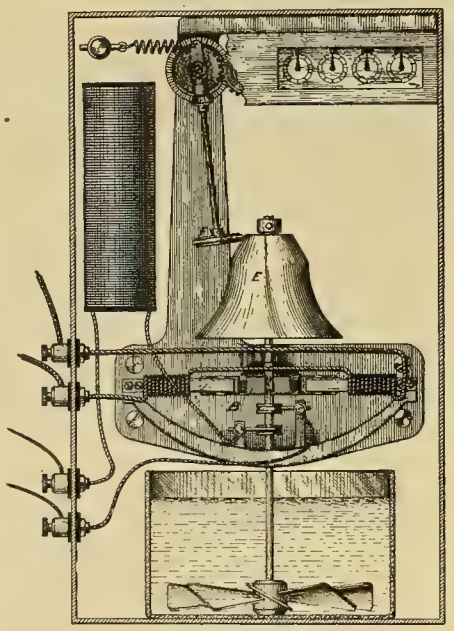
The city of Cedartown, Ga., will hold an election on June 9th, to vote on a proposition to issue $50,000 of bonds for the erection of an electric light plant and the construction of a sewerage system and waterworks.

The Freeman Meter.

The principle of the electricity meter illustrated in the cut, which is the invention of Walter K. Freeman, Brooklyn, N. Y., may be explained as follows: If an electric motor is connected into an electric circuit and a predetermined current is caused to flow in the circuit, the armature of the motor will be given a certain rate of revolution. If more current is caused to flow through the circuit the rate of revolution will be increased. This increase in rate of revolution of the armature is not, however, directly proportional to the increase of current flowing, but varies to a considerable degree, and if a curve be developed, indicating the performance of the motor under the influence of an increased current, it will be found to be an irregular one.

In devising this meter Mr. Freeman connects in the circuit whose current it is desired to measure and record, a motor *B* and causes the motion of the armature of the motor to be communicated to a form *E* bearing the characteristic curve developed by observing the performance of the motor under an increasing current. The form *E* operates a recording mechanism whose reading at any time will indicate the amount of current that has flowed in the circuit.

For co-operation with the form *E* a friction wheel *F* is mounted upon a shaft which drives



THE FREEMAN METER.

a recording mechanism. This friction-wheel is kept in contact with the form by means of a spring or weight. Upon the other end of the shaft that is connected to the armature, a propeller wheel is mounted. This propeller is adapted to operate in a vessel containing some homogeneous liquid, though it may operate in the air. With an arrangement such as this, when the armature of the motor is put into rotation by the passage of the current, the spindle carrying the form and the propeller wheel, is caused to rotate, and by reason of the resistance offered by the liquid the shaft is caused to rise more or less, according to the rapidity with which the armature is caused to revolve. This action brings the appropriate portions of the form successively into rotative contact with the friction wheel and causes the latter to revolve more or less rapidly, according to the diameter of the form at the point or points where it makes contact, thus advancing the recording mechanism. Any diminution in the current passing will, of course, produce a less rapid revolution of the armature and cause the shaft bearing the form to descend by gravity, so as to bring a portion of the form having a less diameter into co-operation with the transfer friction wheel, and in this way decrease the speed of the recording mechanism.

Fire recently destroyed the station of the Elizabeth City, N. C., Electric Light company. The plant will be re-established.

Electric Light from Oil.

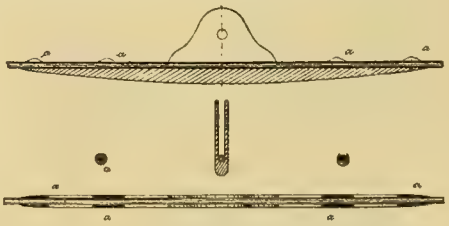
Priestman Brothers of London, England, have just supplied G. Aspland of Boston, England, with one of their three-horse power oil engines and a Taunton dynamo, the latter made by F. M. Newton of Taunton. The engine and dynamo are mounted upon a bogie fitted with road wheels complete. The dynamo is driven directly from the fly-wheel of the engine, as shown in the illustration, at a speed of 1,300 revolutions, and supplies four arc lamps with a current of six amperes at a pressure of 60 volts. The candle power of each lamp is about 1,000. All wires to the lamps are attached to main cables by means of brass clips which, can be detached at a moment's notice. The installation is for lighting up a patent switch-back. Priestman Brothers are now making oil engines from one-horse power to 25 horse power. A large number of engines have been supplied for electric lighting, orders having recently been executed, among others for this purpose, for the Victorian and New South Wales governments.

The Montreal Convention.

It is evident that the hospitable Canadians intend to leave no stone unturned to make the visit of the delegates to the mid-summer convention of the National Electric Light Association a pleasant one. The provisional committee holds frequent meetings at the Windsor hotel. At the last one there was a large attendance, and Prof. Bovey of McGill University presided. The several sub-committees reported gratifying progress and it was stated that the interest in the forthcoming convention was daily increasing. A communication from Governor-General Stanley, in which he expressed his fullest sympathy with the objects of the convention, was read. The governor-general hoped to be able to attend in person, which he certainly would if the gathering were held in September; under any circumstances he would be most happy to co-operate with the convention.

Wheeler's Trolley Support.

The device shown in the cut consists of a metallic basket or trough adapted to receive the trolley wire, and also formed so as to admit the passage of the trolley wheel. This hanger is provided with ears which can be bent over the trolley wire after it is placed in the trough, and will hold the wire in proper contact with the trough. The surface contact between the trough and the trolley wire is so large that the resistance from the wire to the trolley wheel is inappreciable. The outer portion of the trough is shaped to allow the trolley to roll upon it, and as long as the wheel is in contact with one of the ears *a* the current passes through that ear. This is the distinguishing feature of the invention—that the ear itself forms part of the conductor when the trolley wheel is in contact with it. The ends of the trough are thinned to allow the trolley wheel to pass easily from the wire to the sur-



WHEELER'S TROLLEY SUPPORT.

face of the trough and from the trough to the wire again. The trough is sustained by one or two hangers. The wire, of course, may be soldered to the basket ears, but that is unnecessary when the ears are numerous, and practical advantages arise from dispensing with solder and holding the wires in place by the ears only. The ears may at any time be straightened and the trolley wire readjusted, as is often desirable.

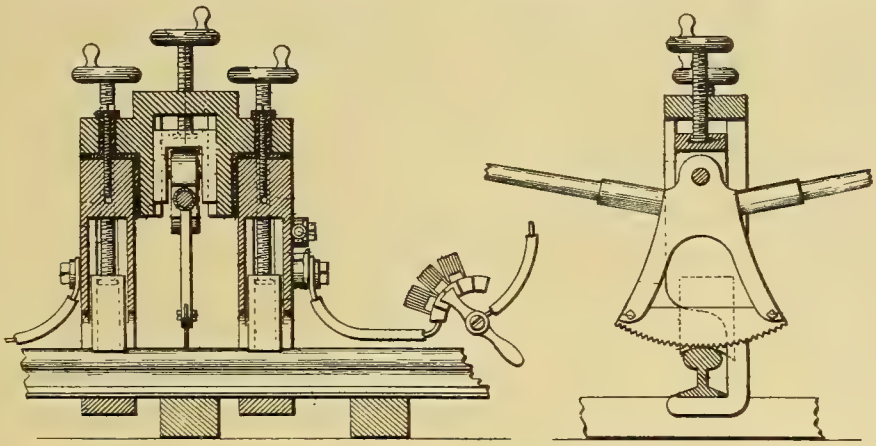
The hanger was designed by Geo. K. Wheeler of the railway department of the Thomson-Houston company, Chicago.

The Toledo Electric company of Toledo, O., proposes to erect a new station.

Repairing Metal Structures by the Aid of Electricity.

In many instances where a metal structure is defective and it is desired to repair it without weakening it or changing the design, extensive portions are removed and new whole pieces inserted. For example, a defective spot in a rail may necessitate its removal. With the view of facilitating such repair work, Elias E. Ries of Baltimore, Md., has devised an apparatus in which he brings to his aid the electric current.

The operation of the machine employed, which is illustrated in the cut, is described by Mr. Ries substantially as follows: Assuming that it is desired to remove a defective section of a rail without taking the latter from the ties or changing its relation to the other rails of the track, the clamps are first expanded and the saw frame elevated, and then the clamps are placed at the point to be cut—that is, at one side of the defect in the rail, with the fixed clamp-jaws under the rail flanges. The followers are then forced against the thread of the rail by manipulating the screw-rods. This operation, it will be seen, will secure the entire device firmly to the rail. The saw frame is now depressed by turning the screw rod until the saw is almost in contact with the rail, as shown in the drawings. The parts having been adjusted as described, the switch lever is turned on its pivot to complete the circuit, and the electric current will then pass from the generator through the clamps and intervening rail. The section of rail between the clamps offers sufficient resistance to the passage of the electric current to be heated until in a softened or plastic state. The saw frame is now rocked on its pivot by a manipulation of the handles, and at the same time it is fed downward by the screw-rod, and the teeth, it is claimed, easily and rapidly cut into the softened metal until the rail is divided.



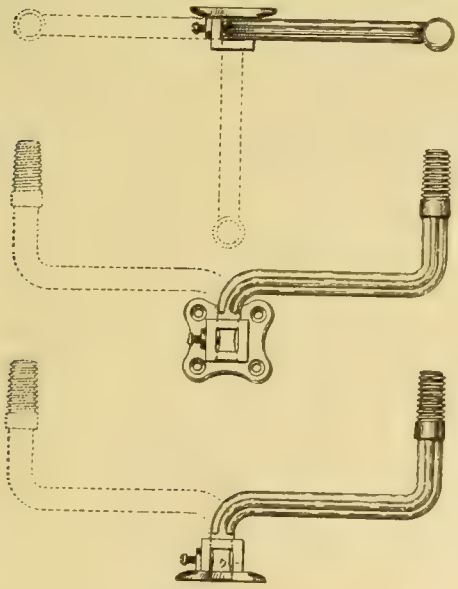
REPAIRING METAL STRUCTURES BY THE AID OF ELECTRICITY.

After the defective portion has been removed by means of the rocking saw, a sound piece of rail is inserted, and the current is employed to weld it into place.

Adjustable Bracket.

The features of the fixture illustrated in the cut will be understood at a glance. The bracket arm has at its outer end a pin threaded to receive an ordinary insulator. The inner end of the arm is provided with a squared shank that extends at right angles and has hollowed sides, as shown, for the end of a set screw to enter and furnish security against accidental displacement.

When the bracket is to be used on a vertical wall the socket is secured with its base resting against the side of the building and the bracket arm is then inserted. If the bracket is to be placed near the middle of the side of the building, then the arm may be placed in the socket so as to stand at right angles to the side and base of the bracket. A number of positions may thus be obtained. In each case after the arm is placed in the socket the set screw must be tightened to secure it in place. This bracket is the invention of Thos. H. Brady of New Britain, Conn.



ADJUSTABLE BRACKET.

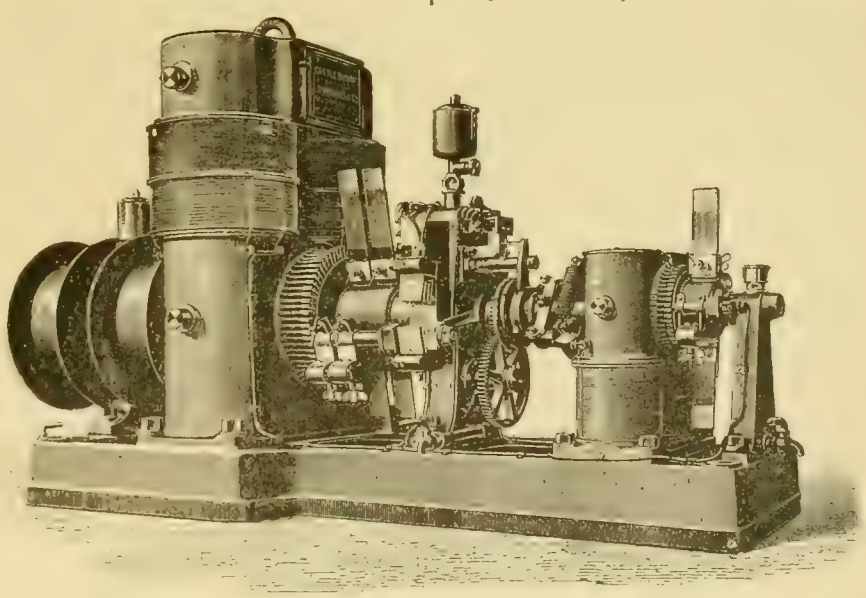
Holmes' Dynamo for Train Service.

In the many attempts which have been made to light trains directly from a dynamo the greatest trouble has been due to the variations of speed. J. Holmes of Newcastle, England, claims to have overcome this difficulty and explains his method and the machine used substantially as follows:

Practically the electromotive force of an ordinary separately excited dynamo varies directly as the speed, so if the speed be increased, say, from 500 revolutions per minute to 1,000 revolutions per minute, the electromotive force will be doubled. The electromotive force varies directly as the strength of the magnetic field, so that, if the strength of field of a separately excited dynamo be reduced in the same proportion as the speed at which its armature revolves be increased, the electromotive force of the armature will remain practically constant.

To produce this result two dynamos are arranged having their armatures upon the same shaft, so as to revolve together, but influenced by separate magnetic fields. One is the main generating machine, the other is for regulating the strength of its magnetic field. The magnets of the machines are separately excited from an external source, such as a set of accumulators, and the magnets of the generating armature are provided with two distinct exciting circuits. One circuit is an ordinary high resistance shunt circuit and the other is of less resistance and is coupled up to the source of current so as to have the small regulating armature in series with it. The regulating armature is so coupled up that its electromotive force opposes the electromotive force of the regulating armature and external source of supply. The high resistance shunt circuit is so proportioned that, at the highest speed at which it is intended to run the generating armature, it, without the aid of the regulating circuit, will give a magnetic field of an intensity proper for the required electromotive force in the generating armature. When thus driven the second exciting circuit ought to have no current passing through it, and this is secured by making the electromotive force of the regulating armature at its highest speed equal and opposite to the external source of electromotive force produced in the second coil of the generating machine. If, however, the speed falls, the electromotive force of the regulating armature is reduced in the same proportion, and is no longer equal to the external electromotive force, and a current will flow through the second exciting circuit of the magnets of the generating dynamo, thus increasing the intensity of the magnetic field to make up for reduction of speed, maintaining a practically uniform electromotive force.

The armature is driven by belting from the axle of the guard's van, and a set of accumulators excite the field magnets. A centrifugal governor automatically switches the storage batteries in or out. The brushes which collect the current from the two armatures are made of wire gauze, and are placed radially, the lead being automatically altered to suit the direction of rotation. The connections to the armatures are changed at the same time.



HOLMES' DYNAMO FOR TRAIN SERVICE.

This dynamo is used by the Midland Railway company for its express trains, and has also been applied to French, German, and Russian railways. The cut is from *Industries*.

It is announced that the electric light plant at Bismarck, N. D., has been shut down on account of lack of support by the city authorities.

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W. A. KREIDLER, - - - - - - - - - Editor and Publisher.
J. B. O'HARA, - - - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - - - Associate Editors.
W. E. KEILY, - - - - - - - - - - - - Associate Editors.
J. L. BAKER, - - - - - - - - - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THROUGHOUT the controversy between the electrical and construction departments of the World's Columbian Exposition over the size of the electrical building and its location as well as the question of dividing the exhibit, the electrical people have maintained that the construction department and the officials generally had no conception of the vast importance of the electrical features. One effect of the agitation was to impress these officials with an idea of the importance of the electrical interests. The persistent fight made against the outrageously inadequate quarters of the electrical department led the directors and commissioners to look into the matter. It is true this was not done until it was too late to grant all the demands of the electrical department, but the assurance is given that material concessions will be made in addition to those already granted. There is now under consideration a plan for erecting the electrical building on the site allotted the mines building. This will not only bring the electrical exhibits closer the loop in which will be located the generating station, but it will also, it is thought, afford an opportunity to enlarge the structure.

The directors have agreed to place at the disposal of the electrical department all the space needed within the loop for a power plant. This power house will not be as far from the electrical building as was at first supposed, if these arrangements can be made. In the first place there will not be the tracks about the building which were anticipated at the beginning. This will enable the department to gain fifty or one hundred feet.

It is, of course, to be regretted that the directors could not see their way clear to correct the original plans so as to place the entire exhibit under one roof, and thereby show all applications of electricity in connection with the generating plant. This, of course, would be the proper course to pursue, but as the plans were prepared without consulting the wishes of the prospective exhibitors or the representatives of the leading electrical houses they were botched. It took a long time to convince the officials of the great mistake they had made; then it was too late to fully correct it. The agitation, however, produced good results, and the electrical interests are to be congratulated on securing the favorable concessions mentioned.

The contracts for the erection of the building were to have been awarded last Tuesday, but the letting was postponed on account of slight irregularities in some of the bids.

DUBUQUE, Ia., claims to have the first complete system of electric traction by storage batteries in the world. Favorable reports of the operation of the system have so far been received, and the final verdict, after the lapse of sufficient time to allow a comprehensive judgment, will be awaited with interest.

THE question of the right of grand juries to compel telegraph companies to divulge the contents of telegrams relating to matters under investigation is again up—this time in California, where the superintendents of both the Western Union and Postal companies have been summoned to produce the telegraphic correspondence relating to the Chilian war. There is no precedent which warrants the courts of that state to compel the companies to take this action. On the contrary, the rulings have always been adverse to such a course. In Illinois and in New York a different view of the case was taken. It is now to be seen what course will be pursued in the present case, which is before the United States grand jury.

THE electric welding process is coming to the front in the West. Hitherto the progress in this line has been in the East, but western manufacturers are now beginning to appreciate the advantages of the electric method. In this issue there are presented a description and views of a welding installation at Harvey, Ill. The equipment is applied to general work in the smith shop of a carriage factory. Power is obtained from the factory engine, and the same dynamo which furnishes current to the welder also supplies a number of incandescent lamps strung throughout the shops. The Harvey plant is an interesting one, and as its great usefulness is now being demonstrated we may look for a further application of the art, not only in carriage work, but also in other lines of manufacture.

THE report of the Rapid Transit commissioners of New York city is practically a declaration that the solution of the problem is to be found only in the adoption of electricity as a motive power. The commissioners have devoted much time and study to the question, they have gone over the several routes proposed, and examined carefully the claims of each and they have given equal attention to the numerous systems advocated. After hearing all the arguments and personally examining the plans they have decided that the electrical engineer is the man to look to for relief. This is the greatest victory thus far achieved by the electric railway in this country. It affords the electrical engineers the opportunity they have long been watching for, and they no doubt will make the most of it.

THE annual and general meetings of the American Institute of Electrical Engineers just closed proved both interesting and instructive. The papers covered a wide range of subjects. The discussion of means for securing rapid transit in New York city afforded an excellent opportunity for presenting the claims of the electric motor, and the paper of Frank J. Sprague proved one of the most interesting of the list. Much of it must necessarily be of interest only to New Yorkers and those who have given the problem of rapid transit in the metropolis close attention. The subject itself is one of general interest, and there is a special interest in it among electrical engineers, especially in view of the action of Rapid Transit commission. In the substitution of electricity for other motive powers rests the only hope of New Yorkers in securing a permanent system of rapid transit.

GRADUALLY the daily press is arriving at the conclusion that "the deadly electric current" is not so deadly after all, and that, as the *Chicago News* expressed it in a recent editorial, "a very large percentage of the accidents and deaths attributed to electricity have been due to sheer carelessness or wanton horseplay." This is a gratifying indication that the public generally is ceasing to regard electricity with that panicky fear which has characterized it in New York and some other large cities where accidents due to electric light wires have occurred. Like any other powerful manifestation of energy, electricity should always be treated with an intelligent appreciation of its tremendous latent possibilities, either for good or evil; but when this feeling is replaced by a blind and unreasoning terror, the community in which such a panic prevails is simply placing obstacles in the path of progress upon which it itself should travel.

IN another column there is described an electrical method of repairing rails. The inventor proposes first to soften the metal by the passage of a great volume of current and then by means of a saw cut out a defective portion. A sound piece of rail is then fitted into the gap and welded electrically into place.

In describing this process and the apparatus employed there was no statement as to what would be the capacity of the current generating plant. Where an ordinary iron or steel rail is to be heated or welded the volume of current required would be simply enormous. Judging from the published figures as to the horse power needed for making different welds, we are inclined to believe that the size, weight and portability of the engine and generator, which would be the essential accompaniment of the welder proper, are serious questions. There is, of course, no doubt that rails can be welded, but when we come to consider the practicability of applying the process not in the shop but along the road, we are tempted to remind inventors that in their efforts to work out the details of the problem they should not overlook the fact that the current generating plant is the all-important and most essential portion of a welding or heating outfit.

Telegrams in the Chilian Trouble.

The question of the right of a grand jury to require a telegraph company to divulge the contents of telegrams relating to a matter under investigation is again raised, this time in California, the occasion being the Chilian controversy.

Superintendent Jaynes of the Western Union Telegraph company and Superintendent Storrer of the Postal Telegraph company of San Francisco have been summoned before the United States grand jury at Los Angeles, the subpœnas calling upon them to produce all the dispatches that have passed over their systems during the last month relating to the Chilian war and all messages from and to any persons connected in any way with the insurgent movement. It is said that both managers consulted their attorneys and that they have decided to disobey the order of the grand jury on the ground that the messages are of a secret character and made sacred in the eyes of the law from outside scrutiny. Unless the United States courts establish a rule contrary to the one now in vogue in California the telegraph companies cannot be forced to comply with the order. An analagous case was decided by Judge Maguire of the Superior Court in San Francisco in 1888 and afterward ruled upon by the Supreme Court of the state. In the case of Jones against Brandenstein Judge Maguire required the Western Union Telegraph company to produce all dispatches sent or received by the defendants on every day for the period of six months. The subpœnas specified each day separately, giving the names of the parties and the substance of the dispatches desired. Superintendent Jayne refused to comply with the order, claiming that it would cost $100 to make the search for the messages. The court ordered plaintiff to deposit that sum and then reiterated the demand. Mr. Jayne still refused, whereupon the court find him $100. An appeal was taken to the Supreme Court, and Judge Maguire's decision and order were overruled on the ground that the court had no power to compel the telegraph company to make a search for dispatches extending over a period of a day or two. Judge Maguire, in commenting on this decision recently, is quoted as saying that "the rule is unquestioned that a telegraph company can be compelled by subpœna to produce certain specified dispatches in court, but a subpœna requiring the production of all dispatches passing between persons named within say a month, whether the subject matter be or be not specified, is too general and cannot be enforced under the ruling of the Supreme Court."

Nothwithstanding this precedent Judge Ross of Los Angeles issued an order directing Mr. Jayne to produce all the telegrams in his possession which passed between Ricardo Trumbull and George A. Burt, by whatever devices or initials or names they may be signed, relating to the schooner Robert and Minnie and the insurgent steamer Itata, which were sent or received since April 1st.

The same point was raised in the celebrated Cronin case when the grand jury called upon the Western Union Telegraph company to produce all the telegrams and cablegrams sent or received by persons charged with complicity in the tragedy, extending over a period of two months. This the company refused to do. Attention was called to the fact that the Illinois statute required that all telegrams be transmitted secretly and their contents divulged to no one excepting the person to whom the dispatch was addressed. Furthermore, the power to demand all telegrams sent or received by any person for two months plainly opens the doors for great abuse at the hands of an evil-disposed or ill-advised grand jury. The court, however, persisted that the company should present the documents or stand committed for contempt, and an order to that effect was served upon its representative. The company thereupon produced the desired telegrams under protest.

The Capital City Electric Light company of Des Moines, Ia., has filed notice of a suit against the city. The company claims that the city is trying to repudiate a former contract, in order to make one with the Des Moines Water Power company. It therefore seeks to hold the city to the old contract.

Storage Battery Road at Dubuque, Iowa.

The Dubuque, Ia., *Times* of a recent issue has an enthusiastic description of the new electric railway system of that city. Storage batteries are used to furnish the current, and the Dubuque paper claims that, although single cars have been propelled for a short time by this system in other cities, "the Dubuque Street Railway company is the first to equip its entire system with this latest and well nigh perfect invention for the cheap and rapid transportation of the people."

Nine cars are already in operation. A section of the floor of each car can be lifted up, disclosing the racks containing the accumulators. Each car is supplied with three incandescent lights. The electrical equipment was furnished by the Electro-Dynamic company of Philadelphia.

The new system appears to give great satisfaction, and already representatives of other cities have visited Dubuque to inspect it. It has inspired the *Times* man to give utterance to the following eloquent description: "There is no tangle of overhead wires to spoil the view. But down the street, swiftly and silently save for the loud ringing of the warning gong, comes a beautiful car, skimming over the rails like a thing of life, yet so perfectly under the control of the motorneer that it can be brought to a standstill in half a car length. There is no rocky motion, no jarring. The cars run as smoothly and with apparently as little friction as a bird flies through the air."

Use of Oil as Fuel.

J. T. Boustead, superintendent of the Minnesota Brush Electric Light company of Minneapolis, was in Chicago last week. Mr. Boustead reports that his company is building a two-storied addition to its station, the ground dimensions being 48 by 95 feet. The plant is to be greatly enlarged this summer. Recently a generator of 200 horse power capacity, to supply current for motor service, was added to the installation.

This is the company that burns oil under its boilers as fuel. The authorities of the World's Columbian Exposition will be interested in Mr. Boustead's statement that the use of oil in a power plant is an unqualified success. There is neither smoke nor odor; no coal to carry in or ashes to wheel out; and, in addition to these advantages, oil has proven itself to be actually more economical than coal. These are facts that should be borne in mind by those who assert that a power house adjacent to the electrical building at the World's Fair would be a nuisance, owing to the smoke from its stack. As has been previously pointed out in this paper the use of oil is practicable, and smoke could thus be avoided.

David Brooks' Death.

The death of David Brooks is announced. The deceased was 71 years of age, but up to the time of his death took an active interest in everything that transpired in electrical circles. In his early days he took a prominent part in the development of the telegraph, and invented several devices of value. But the most important work of his life was in connection with the introduction of oil as an insulation. He was a pioneer in this field.

David Brooks was born at Brooks Vale, Conn., Jan. 26, 1820. At the age of 25 he entered telegraphic service under Henry O'Reilly, and was engaged on the first commercial line in this country. He received over this line, which extended between Harrisburg and Lancaster, the first message transmitted in Pennsylvania, and it is believed the first sent in the country, excepting those over the government experimental line. He also had the honor of sending the first message across the Alleghenies, Dec. 25, 1846. This line was built for the Atlantic & Ohio company between Philadelphia and Pittsburg. He constructed the first telegraph line in Mexico, and when this was completed returned to this country and occupied several positions until 1862, when he retired from the telegraphic service. Mr. Brooks was a prolific inventor, and since his retirement from telegraphy devoted himself to the introduction and improvement of his inventions. His work in developing a system of underground conduits in which oil is used as an insulator was the most important of his inventions. His first experiments in this line were discouraging, but he persisted through numerous failures, but when he finally succeeded little attention was given the result of his labors for some time. Now, however, more attention is directed to his work. Mr. Brooks was a close observer, and an enthusiast on the question in which he was so deeply interested. He visited Europe several times with the object of studying the methods and improvements that obtained there.

Rapid Transit for New York.

The report of the Rapid Transit commission of New York is a source of gratification to electrical engineers, as it indicates a marked advance in the spirit of the age. A year ago the idea of employing electricity as a means of propulsion was scouted by all save a few engineers. To day the men intrusted with the solution of the problem recommended "an underground four track railway under Broadway, from a point at or near South Ferry to Fifty-ninth street, thence under the boulevard to a point at or near One Hundred and Sixty-ninth street (with such length of viaduct at and near Manhattan street as may be necessary), thence under Eleventh avenue, or under private property immediately to the west thereof, as may be found most convenient, to such point as the contour of the ground may determine; thence by a viaduct across Spuyten Duyvil Creek, and by tunnel or viaduct to the city limits."

It is further recommended that the motive power for such railway shall be electricity or some other power not requiring combustion within the tunnel.

It is true all this was anticipated and outlined by those best acquainted with the requirements of the metropolis, yet the joy of the electrical fraternity is not diminished in the least. It is a great victory for the electrical fraternity. The preliminary surveys will be made at once, and a detailed report submitted to the board of aldermen.

Incandescent Lamp Litigation.

Judge Wallace of the United States District Court at New York listened to the arguments in the litigation over incandescent lamps last week until he was thoroughly bewildered. The suit was brought by the Edison Electric Light company to enjoin the United States Electric Lighting company from the manufacture or sale of incandescent lamps. The magnitude of the interests at stake will make the caseone of the most important that has been tried since the great telephone dispute was settled.

The Edison interests were represented at the trial by Clarence A. Seward, Grosvenor P. Lowrey and Richard N. Dyer, counsel, and Eaton & Lewis attorneys; while for the United States company Edmund Wetmore, Gen. Duncan and Frederick H. Betts as counsel and Kerr & Curtis, attorneys, appeared.

The question at issue is whether Edison's patent, granted in 1880, is sufficiently broad to give to him the exclusive control of the manufacture, sale and use of the incandescent electric lamp. The court room was literally turned into a lecture room while Lawyer Richard N. Dyer, through the means of illustration, presented arguments to prove that all incandescent lamps of inventors other than Edison were failures commercially up to the time Edison received his patent. Lawyer Dyer occupied two days and completed his train of reasoning Wednesday evening. The defense, in the hands of Gen. Samuel A. Duncan, began Thursday morning The general claimed that his clients, the defendant company, did not infringe any of the "so-called" Edison patents, and further that Edison's claims for priority of invention in the matter of incandescent electric lamps are absurd.

The defendants insist that the patent in suit cannot be lawfully interpreted to cover the broad claim which the plaintiff makes for it; that it only covers the specific lamp described, and that high resistance incandescent lamps are the result of the joint inventions of a host of others, both in England and this country. This patent has now but a short time to run, it being over eleven years since it was originally issued.

Divorcing Light from Heat.

Robert W. Prentiss has an interesting article in *The Chautauquan* for June, from which the following is taken: Professor Langley has shown that our best sources of light are surpassed by nature in one very important respect—the production of light unaccompanied by heat. Of the energy supplied by gas and oil for lighting purposes much more than 99 per cent. is given out in heat. Even in the electric arc light the waste is 90 per cent. and in the incandescent lamp 95 per cent. The insect world is much more economical. The most careful measures made with the delicate bolometer fail to show any sensible heat in the light of the firefly. There is no reason why nature should not be successfully imitated in this respect, and Professor Hertz hopes to devise a method of obtaining better results than we now do, from our present ordinary means, in getting electrical vibrations similar in every respect to those of light, but of greater wave length. By modifying his original apparatus he has some prospect of producing waves so much shorter that all of them will be luminous; in other words, of developing a new source of light without heat. This result, if successful, will be an entirely new method of illumination differing as widely from the present electric lights as they do from gas light and lamp light, and surpassing them all in economy and comfort.

Electric Railway Controversy in Brooklyn.

Probably the bitterest fight ever made against electric street railways has just closed in Brooklyn, for the present, at least, with a temporary victory for the opponents of the improvement. Every method known to man was employed to defeat the measure, and many of the practices resorted to were questionable. Reports prepared for the occasion were sent to Brooklyn from Boston and other cities in which the electric system was grossly misrepresented, and the daily papers of Brooklyn and New York were filled with electric "fakes" tending to alarm the people. All of this had its effect in certain quarters.

The State Railroad commission has decided that the Coney Island & Brooklyn Railroad company cannot for the present change its motive power from horses to the overhead single trolley electric system on that part of the road between the corner of Franklin and Coney Island avenues in Flatbush and the corner of Ninth avenue and Ninth street in Brooklyn. Gen. Henry W. Slocum, the president of the road, first applied to the park commissioners for leave to cross the plaza at the southern entrance to Prospect Park with his electric cars, and his application was refused. Then he tried to induce the Brooklyn aldermen to grant him permission to run his cars by the single trolley system to Ninth street and Ninth avenue, but the aldermen took no action, and he finally carried his application to the State Railroad commission.

There were two hearings in Brooklyn, and the corporation counsel, acting for the park commissioners, bitterly opposed the petition, and Assistant Corporation Counsel Salmon raised the point that Gen. Slocum had not received the majority of consents of abutting property owners because he had failed to secure the consent of the park authorities. The Railroad commission, in denying the company's application, says that the consent of the city authorities is necessary, as a property owner of parks and public places, where such consent is necessary to give a majority in value of the abutting property upon that portion of the road as to which a change of motive power is proposed. The board knows no reason why the petitioner should not apply to the General Term of the Supreme Court for a commission, and says that the approval of a large majority of the property holders other than the city is unquestionably obtained.

The methods employed to defeat the introduction of the trolley system in Brooklyn were certainly discreditable. Here is an extract from the Brooklyn *Citizen*: 'We therefore advise our readers to rest serenely in the assurance that the commissioners mean to do what is right, and that they will not find it proper to sanction the introduction of a dangerous, inconstant, unsightly, noisy, ill-smelling and altogether offensive form of motive power for no better reason than that it would enable railroad companies, which are already making unreasonably high profits, to add still more to their annual dividends on preposterously over-watered stock."

Commenting on this silly assertion the Rochester, N.Y., *Herald* says: "We can understand how a person who doesn't know anything about electric cars or the trolley system as they actually appear and work in a large city can attribute to electricity as a motive power danger, inconstancy, unsightliness and noise; but we are puzzled to know where the bad smell comes in.

"Our Brooklyn contemporary evidently has had little experience with electric cars. None of the evils it complains of troubles Rochester. The trolley system is not nearly as objectionable as those who have had no experience with it imagine. As for the superiority of electricity to horse power, there is simply no comparison. Rochester would have a riot if there were an attempt to go back to the use of horses."

As a result of the fight in Brooklyn over the introduction of the trolley system the Atlantic Avenue Railroad company of that city has issued a pamphlet entitled "What is the Truth About the Electric System for the Propulsion of Cars in City Streets?" A large number of letters from other cities praising the trolley system are presented, including indorsements from the mayors of Albany, Rochester and Cleveland.

Franklin Experimental Club.

At the last meeting of the Franklin Experimental club, of Newark, N. J., Professor Geo. C. Sonn delivered an interesting and instructive lecture on "Seismology," or the phenomena of earthquake disturbances and methods of studying the same. Professor Sonn reviewed the various theories prevalent upon the subject of earthquakes, tidal waves, etc., and explained the methods adopted from the earliest times to the present day in the study and recording of the various disturbances going on in various parts of the earth's structure. The lecture was illustrated by magic lantern views of the most important earthquakes and their effects in Japan, Java, Sandwich Islands, Lisbon, Charleston, and elsewhere, and also by diagrams, prepared by Professor Sonn, of the electrical and other methods employed in recording the time and duration of the disturbances, the number and general character of the movements. Some interesting pictures are shown of various buildings and the effects of the shocks upon structures placed in certain positions, and he explained that, as nearly all of the impulses moved in one direction, it was customary in earthquake countries to pass stringent laws stating how buildings were to be set, whether windows and doors, etc., would be allowed in walls which ran in certain directions, relative to the seismic movements, the character and material employed. The president exhibited some interesting samples of lava and earthquake souvenirs collected by him at Herculaneum, Pompeii and the Island of Ischia. Professor Sonn will sail for Europe shortly, and during his trip abroad will visit the electrical exhibition in Frankfort and will prepare an interesting report for the Franklin Experimental club.

Armature Reaction in Constant Current Dynamos.

After the reading of Prof. H. S. Carhart's paper on "Armature Reaction in Constant Current Dynamos" at the last meeting of the Chicago Electric Club the following discussion took place:

LIEUT. F. B BADT: The points Prof. Carhart makes as to the neutral line are remarkable. I never saw them mentioned in any of the text books; and I think the points made constitute a discovery of high value. I am not able to even suggest anything for discussion in regard to what the professor has said. I can only say that I believe in his theory.

PROF. CARHART: I have learned since I wrote this paper that another method has been devised, different from mine, and with experiments of the most delicate kind, the result is precisely the same.

ALEX. DOW: When I undertook to prepare my paper which was read about six weeks ago I wished that I could get one of those machines for the purpose of testing some of those theories, but I did not get it. The experiments with open coil machines are complicated by the action of the idle coils. It is practically impossible to get a potential curve from them. I mentioned in my paper that there had come into my hands a four hundred ampere closed coil constant potential dynamo which had a sparkless commutator and the property of allowing the brushes to be carried far forward. I took a number of potential curves, such as Professor Carhart took from this machine. I took them with no load, with a load of 20 amperes, and with a load of 200 amperes. I set the brushes just as I would set them in practical work. I was thinking simply to develop the fact that the armature reaction played a great part in the regulation of brush rocking machines, and I did not endeavor to ascertain the neutral line at all and therefore I cannot put forward those curves for comparison with those of Professor Carhart. I think my brushes were very little in front of the proper neutral line at all loads. I did not make the observation, however, that in this machine, and in constant current machines the condition of a uniform field did not appear to be the essential one for successful regulation by rocking brushes. That is opposed to Prof. Carhart's theory. The condition that was essential seemed to me to be uniform induction, and that is quite a different thing from uniform field. Theoretically a uniform field will give you the sine curve of induction; but you can never get a machine of uniform induction.

PROF. CARHART: I should have said uniform induction instead of uniform field.

MR. DOW: If the professor makes that change, then I am silent on that point. There is a most important distinction between uniform field and uniform induction. If you wish to get uniform induction, your field will be far from uniform. A very nice illustration of this is seen in several well known machines, for instance in the Sperry machine and in a machine which Prof. Badt can tell us about. In this last named machine the middle of the pole pieces was cut away, The reverse of this is the practice in constant potential machines. In the constant potential machine you seek for uniform field with small induction near the brushes. In the constant current machine you seek for uniform induction, and to gain that you must have an irregular field. Mr. Weston, who is, I believe, the pioneer in the analysis of fields in constant potential machines, pointed out and adopted the method in his practice, that to secure a sparkless commutator and a wide neutral point which would remove the necessity of changing brushes, it was necessary to cut away the edges of the pole pieces, so as to have the poles approach the armature in the middle and fall away at the sides Now this practice or its equivalent you will find in every machine built for constant potential work, which runs with little change of lead, and with sparkless brushes. But you find the exact reverse in the constant current machines. You will find the poles approach at the edges and are cut away in the middle. About two years ago, in experimenting on the regulation of a large arc dynamo, I noticed that there was very little change in the value of the field current when the field was regulated for a small load. I started to ascertain where the regulation came from and concluded that armature reaction was the source. My paper, read six weeks ago, was written before Professor Thomson's paper, was read before the Electric Light association, and was in the hands of this club before the correspondence between N. Tesla and Professor Thomson had taken place. I now find that Professor Carhart has been on the same track.

When counter electromotive force is considered as an increase of resistance it is something easy to handle. The practical man sees that the brushes have to go forward, and it is easy to think of the distorted magnetic circuit as a lengthened one. I wish those who make these definitions for us, who teach us the proper methods of thought, would make things simpler. This assumption of counter magneto motive force is like the theory of the counter electromotive force of an arc. The arc lamp of commerce behaves just like a resistance—a variable resistance if it is shunt wound and a constant resistance if differential. I would like to see the counter electromotive force of the arc demonstrated. It would be a step toward the cheap production of electricity from heat.

THOMAS G. GRIER: In the installation of certain machines now on the market the expert is instructed to look after the neutral point. He is instructed to put a third brush about two segments ahead of the second brush and he is told that the neutral line would be directly between those two brushes, and that the regulation of the dynamo is accomplished in this manner. Now all this has been referred to in the paper, and I would like Professor Carhart to explain it. I have never understood the regulation of the dynamo. I thought that the chart before us might be a means of explanation,

CHAS. WIRT: Several years ago I tested a third brush system. I was offered every facility to find out everything about it, and I made a great many observations. After I finished I tried to put my observations together to form some rational theory, particularly as to the reversal of the current in the third brush, which is one of the points the professor has brought out. I am obliged to confess that I could offer no explanation. I tried to get help from the inventor. He did the best he could, but I finally made up my mind that he did not understand it either. After that there was considerable literature on the subject, but it did not aid me any.

I had also an opportunity to make some experiments with third brush potentials on a certain type of dynamo. I noticed the very considerable lead of the brushes at the non-sparking point. I was surprised to find that the point of highest potential was far back of the brushes. A more practical point which my experiments showed me was that the neutral point or non sparking point was a little unsymmetrical on that particular dynamo. It was a dynamo of the horseshoe type, and I found the brushes worked the best when they were a little off toward the side that the horseshoe magnet was on This action was easily explained on the theory that the lines of force were not symmetrical; that the field was a little stronger on the side toward the legs of the magnet.

PROF. CARHART: I think Mr. Dow will remember that I referred to the curve of activity, which is just the same as the curve of induction, as meaning the same thing. In the machine from which this curve is plotted, the activity curve is very irregular; it is not uniform at all. Where I used the term uniform field I meant uniform activity or uniform induction. It is not uniform but every time a pole comes round to where it is not uniform it uniforms it, so to speak. It flattens out any curve there may be in the activity. When the pole gets round there it does its work. I think there is no difference between Mr. Dow and myself on the question of uniform activity.

Now with respect to the lengthening of the air space and to the magnetic motive force. The lines of force are destroyed, as I presume you can all see them in the chart. The curious thing is that, no matter how far you rock the brushes over, the line does not appear to move a bit further. In fact I must tell you that there is some evidence—I am going to experiment on that—there is some evidence that when you rock the brushes forward the neutral line drops back a little; in fact I think, practically speaking, air space shortens a little.

Counter magetic motive force is a perfectly simple thing. I am sure we all understand that when you have two electromotive forces in a circuit you may have them opposed to each other. You can have the one direct or positive, and the other negative. When you do this you have a counter electromotive force. If that were not so the law of the conservation of energy could not possibly be true. If we wind a straight bar magnet with two coils of wire, the direct magnetic force is equal to the counter magnetic force. If you wind two coils and send a current through in opposite directions then you have two opposing forces. It seems perfectly simple to me. You had exactly the same thing here.

I do not know anything about the Waterhouse dynamo. I have read about it, but have never seen one and have never investigated it, so that I am unable to explain anything about that particular third brush machine; but I would like you to remember that there is no reversal of current in this third brush circuit, unless that current is very small. The brush which is higher becomes the lower in the reversal. If you have any portion of the current running through the third brush, there is no reversal that I can find; there is no possibility of it. I have my opinion as to what causes that reversal, but I don't know that I am right. I think there is self induction; you cannot get this by increasing the main current, and it will not produce the reversal. Self induction will do it—it is sufficient to do it at all events. The increased reaction of the armature would cut down the difference nearly to zero, and then you have increased the induction through that coil because there is a bigger current flowing, and if you have a spark there is enough to bridge it over.

PROF. BADT: Mr. Dow made a remark concerning a machine about which I know something. This machine was built by a company in Chicago for arc lighting and has automatic regulation by the shifting of the brushes. A new type of this machine was built, and it didn't regulate. I think that is what he referred to.

MR DOW: I noticed the change in the machine, but did not know the particulars.

PROF. BADT: We made the field irregular by holes in the pole pieces, and just as soon as that was done the machine would regulate. Finally, instead of drilling holes, a rectangular slot was cut right on the top of the pole pieces. It was a four magnet machine. Ever since that was done there has been no trouble with the regulator.

Now I would like to say something about the third brush machine that Prof. Carhart referred to. Mr. Vanderpoele has constructed quite a number of reciprocating electric machines, which are used for drilling, pumping, etc. They all consist of two solenoids whose axes are the same, and which attract or repel an iron plunger that travels to and fro in those two solenoids The two solenoids are connected to a machine giving a pulsating or undulating current. The two terminals of this machine are connected to two stationary brushes on any constant potential genetator, and the connecting wire between the two solenoids runs to a third brush, which is on the dynamo, rotated round the commutator. This third brush is driven at a certain rate around the commutator by gearing. Now one would suppose to look at such an arrangement that there would be very great sparking in that third brush, but as a matter of fact there is no sparking at all. First one solenoid becomes strongly magnetic and then the other, and that of course makes the plunger go to and fro. I simply mention these facts relating to the third brush to show that we do not seem yet to have quite reached the end of the third brush arrangement.

MR. DOW: I don't want it supposed that I deny the existence of counter electromotive or magnetic motive force. But I think our teachers are a little inclined to do

with counter motive forces what we used to do with the induction in the telephone business. Whenever we could not understand anything; whenever a telephone was out of order or would not work properly, just as likely as not it was the fault of the battery, but we charged it to induction, nevertheless; and it seems to me that when a diagram will not go straight, or an explanation is wanted it is charged up to some counter motive force. Under armature reaction one polar tip apparently ceases to be magnetic. My explanation of that is simply that the magnetic circuit is crooked, instead of being comparatively straight, as it was before. In that case the one polar tip will assume, as regards the other polar tip, south polarity. The one will become more strongly north and the other will become relatively south. Fall of magnetic potential is to me as real a thing as the drop in an incandescent circuit. There is a change in the direction of this magnetic circuit; formerly it was across; now it is up and down. I see also a change in its length, and I attribute to that change in its length the reduction of magnetic flux.

F. L. PERRY: I would like to have Prof. Carhart state one thing before he goes. I think I see concealed, so to speak, in his paper a design of a dynamo which embodies a regulator operating on principles which he has explained. Will he once more explain his idea of such a machine, built according to his theory?

PROF. CARHART: If I were going to do any such thing, I surely would not give it away.

MR. PERRY: You gave in your paper the general features of a machine upon which you say such a method of regulation could be carried out successfully. Will you not again state your idea in few words, for the benefit of the club?

PROF. CARHART: You can divide your current from the main brush and the second brush, and you can rock the brushes as you please.

MR. PERRY: You spoke of relative proportions of the armature and the fields. How about these?

PROF. CARHART: That was for regulation of any machine with rocking brushes. You may do it by hand or automatically. The pole pieces should not be too heavy; the armature should be magnetically strong. I do not believe it is necessary to cut away the pole pieces in most machines. I know some machines in which it is done. I know some others in which it is not done at all, and in which, I should say, the pole pieces are entirely too thick. I have seen such pieces in machines in this city since I have been here. It depends upon the armature to some extent. The drum armature machine seems to have the pole pieces cut away. That is because the reaction is greater in this than in the Gramme.

The Practical Aspects of Electric Welding.[1]

BY FREDERIC A. C. PERRINE, D. SC.

The plant with which I have been intimately connected, though not one of the heaviest, is still one making a great number of successful welds in a day, and is one in which the joints are required to be of the highest character, and are subjected to the severest tests. Our attention was drawn to the process at first as a possible solution of a very troublesome problem in preparing and packing iron telegraph wire. For the convenience of the telegraph companies this wire must be put up in bundles, measuring each exactly one-half mile of continuous length. Singularly enough, the telegraph companies, which had for so long accepted as satisfactory cumbrous connections, immediately commenced to complain of the large burr left by the welding machine, and which we had thought unnecessary to remove. An emery wheel solved this difficulty, however, and we were then able to defy them to find the joint at all.

Among the new solutions of old problems accomplished by the electric welding process is that of the manufacture of spinning rings, at Hopedale, Mass. The desideratum of these rings is a uniformly hard surface, to produce which the method has been to stamp the ring from a sheet of metal, and after finishing in a lathe, to case-harden the whole, involving, as one would naturally see, the loss of a considerable proportion of the original sheet. With a welding machine it is possible to form these little rings, about 2½ in. in diameter from a piece of bar iron, and after the burr has been reduced by a series of dies, to finish as before, with the result of a decreased cost, and an equally satisfactory product.

One of the largest and most complete plants at present in operation is at South Bend, Ind., where there are nine machines; one of them for steel axles up to 1½ in. square.

Probably the heaviest work done at present in electric welding is at Johnstown, Pa.

Agricultural machinery has generally been furnished with iron wheels, consisting of a malleable iron hub into which the spokes are upset, and of a rim into which they are upset at the opposite end. The electro-welding machine has given us two new wheels, each of which is supposed to be preferable to the one described. In the first, the hub is cast of malleable iron, with spokes about 3 in. long To these are welded, by one machine, wrought-iron spokes, and again, by another machine, these spokes are upset into the rim, which is itself welded into a tire, the product being a wheel of which the spokes are less liable to rattle loose at the hub. In the second method, the hub is composed of two drop forgings of low grade steel, grooved to receive the spokes; one-half is placed on the base of the welder and the spokes laid in their grooves, then the other half of the hub is put on, and the clamp brought down. The current is then applied and the whole, spokes and hub, welded solidly.

A company at Cleveland, O., is practically welding brass to steel, making as high as 800 welds per day, and thus effecting a great saving in the manufacture of type-setting and founding machines.

Three types of machines of importance are soon to be in use for the purpose of our army and navy, and the early recognition of the importance of this method of manufacture speaks well for the ingenuity of our government designers.

In the new wire-wound guns one of the most important specifications for the wire was that it should be readily jointed by the electric welding process, and in the Crozier gun now constructing the wire will be wound in one continuous piece under a constant and heavy strain.

For the Charleston Navy Yard there is about completed a machine for welding ship chains up to 2-in. diameter links.

The latest development for government work is the manufacture of conical shell and schrapnel for the smaller armor-piercing guns. The electrically welded shells are made entirely of forged point, body and base, which may be finished to approximate dimensions, these requiring after welding a minimum amount of machining.

[1] Abstract of a paper read before the American Institute of Electrical Engineers, May 20, 1891.

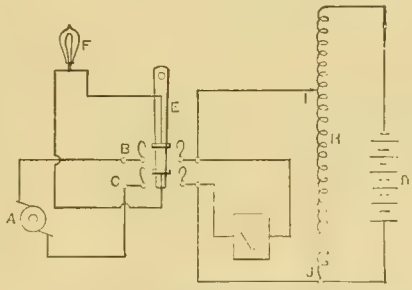
An Alternate Current Potentiometer.[1]

BY GEORGE S. MOLER.

This device is designed for the purpose of determining what values of the potentials of alternating currents will produce given effects, and it is intended to be used mainly in calibrating alternate current voltmeters. It may also be used as a voltmeter, applying it directly to the alternate current to be measured. By means of this apparatus we may determine whether the instrument which is being calibrated changes its reading for other rates of alternations. This is shown by comparing the calibration curves obtained by using widely different rates of alternations.

The instrument, briefly described, is as follows: An inn candescent lamp is so arranged and connected that it can be switched back and forth from the terminals of an alternating current line to those of a direct current line, which can be altered in voltage till the lamp glows with the same intensity when fed by either line. Then, while switched into the direct current line, the voltage of that line is measured by a direct current standard voltmeter or potential instrument, and the voltage so read is equivalent to that of the alternating current, which produces the same effect in the lamp. The switch is so constructed that it snaps back and forth, making the change of connection so quickly that the slightest change of intensity of the light can be easily detected. The lamp has a blackened hood with an opening in one side through which it is viewed while the sliding resistance is being adjusted. This enables the observer to make a much closer setting than otherwise. A very close setting may also be made by observing the slight reflection of the light from the blackened surface of the hood.

The lamp and switch are arranged and connected in the following manner: Referring to the diagram,



ALTERNATE CURRENT POTENTIOMETER.

A is the alternate current dynamo, or line, of which we wish to determine the effective difference of potential in volts between its two terminals, *B* and *C*; *D* is a storage battery or direct current dynamo of higher voltage than the alternate current to be measured. A switch, *E*, made to snap back and forth by means of a stiff spring, changes the incandescent lamp, *F*, from the alternating current to the direct current and vice versa. By connecting the two extremities of a resistance, *H*, to the battery, *D*, and sliding the contact point, *I*, such a place can be found that the intensity of illumination will be the same for both currents.

After the contact, *I*, is adjusted, the standard voltmeter, *G*, is read while the direct current is flowing through the lamp, and this voltage is taken as the equivalent voltage of the alternate current.

A series of lamps of different voltages affords a greater range to the instrument than could be obtained with one lamp only. These may all be connected to the switch and, beginning at the one of highest voltage, one after another may be tried till the best one is found.

For higher voltages than the highest voltage lamp will stand, a number of lamps may be used in series, and the fall of potential, for all, or for each individual lamp, can be measured by means of its voltmeter.

The resistance, *H*, must necessarily be great enough in amount so that only a small current will be allowed to flow through it, so that the consumption of energy will be small.

Instead of having the switch and lamp connected in a shunt line to the resistance *H*, it may be connected in series with *H*, which must then be arranged so that it can be varied in amount. If a source of constant potential large enough in amount is available, the apparatus may be used for a voltmeter for direct or alternating currents. To use it in this manner, we calibrate the apparatus to find the potentials at the terminals of the lamp for different positions of the contact points *I* and *J*, and construct a curve, using the positions of I and J as abcissæ and the differences of potential of those points as ordinates. Then, when using the apparatus as a voltmeter, we read the values from this curve instead of from a voltmeter connected to the switch.

[1] Abstract of a paper read before the American Institute of Electrical Engineers, New York, May 21, 1891.

American Institute of Electrical Engineers.

The papers presented at the general meeting of the American Institute of Electrical Engineers were ably discussed by the members. Following is a synopsis of the remarks on Prof. Francis B. Crocker's paper on "The Perfection of Stationary Electric Motors:

PROF. W. A. ANTHONY: Prof. Crocker certainly has not laid too much stress upon obtaining a large surface of contact between the wrought and cast iron in forming a joint. In making a joint between two wrought iron pieces, it seems to me that a large surface of contact is needed, for any amount of machine work that it is practical to do economically does not produce anything like the surface of contact that you would have in a field magnet made up of one piece. For instance, suppose the pole piece and the core were joined by means of a joint in this case—I venture to say that with any joint that it would be practical to make there economically—you would not have one-quarter of the surface of contact between the two metals that you have when you make it of a solid piece.

W. J. HAMMER: This question of contacts in the fields of a motor calls to my mind some experiments I made at one time in connection with one of the old Edison "Jumbo" machines. As many of the gentlemen here will probably remember the old machines had a large number of fields. It used to be a very difficult thing to get perfect contact, although the surfaces were polished. Where the cores were bolted together there were consequent poles generated, and I made some experiments at one time with a field explorer made from an incandescent lamp. I brought it up to high candle power—until there was this blue fluorescence all through the globe which is very sensitive, and I found it was a very sensitive field explorer, and showed not only the strength of the field in different parts of the poles, but also the magnetic leakage. In passing it over the pole pieces of the machine I found out that there was quite a difference at the points of contact. They formerly had a double row of fields down below with three cores, and where these bolts were put in the surfaces were polished very brightly and tightly fitted together. In some of these places where the bolts were not tightened up I found considerable difference in the lines of force and strength in the consequent poles. There was considerable difference in the efficiency of the fields by tightening up those points, and that was indicated by this sensitive form of field explorer.

ELIHU THOMSON: With reference to the contact between the cast iron and the wrought iron, Prof. Crocker is certainly right in saying that there must be a large amount of surface contact, and that the difference between those surfaces must be a minimum; that is, they should be in very close contact. Now, in order to get the same amount of surface there would have to be a flange or something of that kind. That would occupy a great deal of space. It seems that the advantage that he pointed out then would be that he puts the flange in a hole and takes out some of the cast iron.

EDWARD C. BOYNTON, JR.: I think as regards multipolar machines that the amount of copper depends a good deal upon whether you are using consequent poles or not. There is a machine at present in this city which develops 20 horse power with 150 pounds of copper on the field magnets.

C. O. MAILLOUX: It might be well to state that this subject was carefully investigated in Europe about a year and a half ago, and it was found that the character of the contact made a great difference so long as you confined yourself to rather low densities—low degrees of saturation of magnetism—but when once the density became great, the apparent effect or defect of joint did not make much difference.

The eccentricity of the field is another important point, and it has an advantage which I think Prof Crocker did not mention, namely, the fact that it tends to contain the lines of force within the sphere of the field space rather than to allow them to crowd in toward the corners. It prevents the tendency to increase the density at any particular part of the core, and consequently it reduces the tendency to Foucaut currents. It has also a marked bearing on sparking because it equalizes the potential from the positive to the negative side of the commutator. You get a better curve. There is, perhaps, one point to which he has failed to call attention, and that is the relation which the shape of the teeth and their form, etc., bear to the sparking of the machine. I have had considerable experience with Pacinotti teeth armatures, and I have noticed that the shape of the teeth, their number, also the clearance have a great relation to the sparking.

THOS. D. LOCKWOOD: The discussion seems to have concentrated mainly on the importance of having a perfect magnetic circuit. I do not know that that was the design; in fact I am quite sure it was not the design of the author, as much as to emphasize the necessity of the perfection of joints between cast and wrought iron. I have been specially interested in one remark which did not seem to attract general attention, namely, the supposition that cast iron is cheaper than wrought iron, which is a fallacy, as its permeability is as much above wrought iron as is its price, both being about one-half. While I am in entire accord with the spirit of that paragraph I would venture to so far depart from its terms as to say that cast iron is cheaper than wrought iron, and, therefore, it is not advantageous to use it. (Applause.) I do not think that cheapness should be obliterated from electrical considerations. Substitute for the word cheap, economy, and it is all right, but there is no economy in using cast iron instead of wrought iron, even though its price be one-half.

Dr. Nichols' paper on "A Photographic Study of the Electric Arc" excited the following discussion:

PROF. ELIHU THOMSON: I would suggest that a very good thing to try in this connection would be to actually

produce, if possible, an arc with a sine curve wave; that is, hold the sine curve wave by a large resistance in the circuit or by self-induction, and then investigate the characters in a similar manner. Of course the arc would probably deform it some. I can readily understand that the reason for the curve of current taking the form it does is that the resistance of the arc, falling with the increase of current, naturally the moment it begins, falls to a point only limited perhaps by the capacity of the apparatus feeding the arc. That is, the vertical line shown in the curve of current representing the arc shows that the moment the arc starts there is practically no limit to the current which might pass through that arc if the electromotive force was not extraordinary. That is, under constant potential there would be no limit that would naturally be expected.

DR. OTTO A. MOSES: There is one feature of the arc that I do not recollect to have seen touched upon by any of those who have studied the subject, which I think is here illustrated and perhaps elucidated. The material transmitted, whether with a continuous or an alternating current from one pole to the other, is a volatilized hydrocarbon gas. In that case we have this phenomenon—a column of gas rising or falling according to the direction of the current surrounded by an envelope of oxygen That is an element not to be neglected. We have, of course, in the oxidization of the hydrocarbon a cause of luminosity independent of the current passing. The interior of such a column of gas would naturally present, through photographic influence, a dark spot.

After Dr. Perrine's paper the following remarks were made:

PROF. ELIHU THOMSON: The tendency in the development of electric welding seems to be to produce new processes or to give rise to new applications of mechanical principles such as are seen in the wheels before us. There we have practically a development of a system of work depending entirely upon electric welding and that seems to be the direction in which it is to grow most rapidly.

W. J HAMMER: The electrical engineers have had to meet a good deal of opposition from their brother engineers in the development of the various departments of electricity. The gas engineers we have had to meet with the electric light. In the transmission of power we have had to meet the mechanical and civil engineers. Those two departments of electricity have been pretty well established and our brother engineers have been converted. But today, to use an expression of Prof. Thomson, there is a considerable amount of self-induction present in the minds of civil and mechanical engineers on the subject of electric welding. We would like to have a good many of them here this afternoon and show them some of the practical evidences of the commercial state of the art.

The Future of the Aluminum Problem from The Chemical Standpoint.[1]

BY DR. WM. H. WAHL.

Richards, whose opinion on all questions pertaining to the aluminum problem is entitled to the highest respect, in a lecture on this subject lately delivered before the Franklin Institute, says, "I do not consider the sodium processes, however, as ever likely to take part again in the metallurgy of aluminum. I think their day is past."[2]

I will not venture to dispute the correctness of the conclusion to which this very able and conservative author has arrived, since there are other metallurgical methods that appear to be much more promising. The author I have just quoted, indeed, appears to be of this opinion, inasmuch as he says in the same paragraph. "Although electrical processes are 'on top' at present and, I think, will stay there for some time to come, I am far from considering that they may not possibly be superseded by non electric methods of reduction"

Capt. Alfred E Hunt, in a lecture recently delivered before the Boston Society of Arts, gave an estimate of the probable cost of manufacturing aluminum by the electrolytic method This estimate is based on the assumption that the manufacture shall be conducted on a scale of much greater magnitude than at present, and with the cheapest source of power, namely, water power.

Apropos to this estimate of Capt. Hunt, I wish to remark that it has affored me a most interesting subject for study, and I desire here to declare my conviction that it is in no single item exaggerated on the side of economy. Respecting one of the figures named—that of the cost of water power—I entertained at first some doubts as to its accuracy and to satisfy myself on the point I presented the inquiry to my friend, Prof. Coleman Sellers, an engineer of wide experience and at present one of the Board of Consulting Engineers to the Cataract Construction company, which is engaged in the important work of utilizing on a grand scale the water power of Niagara Falls.

I will take the liberty of quoting to you from a letter which I received from him some data covering the subject of my question:

"The present scheme of utilizing Niagara Falls by the company in which I am interested is by means of a tailrace tunnel under the town of Niagara, and the preliminary work now being done, when completed, in about a year, will throw into the market about 120,000 horse power that may be said to be absolutely permanent and endurable, and capable of being worked for 24 hours in the day.

"It is premature to say what this power will bring in the market, but it is the only example I know of where water power can be counted on as absolutely stable and not liable to any disturbance or delay, and where the price will be comparatively low.

"I should think that you might safely say that it presents the possibility of power being obtained at less than half of what it would cost in any other known case, taking into consideration all contingencies. Small amounts of power may be obtained from streams of water of a reasonable degree of stability and far away from existing markets as low probably as $4 or $5 per horse power per annum, but this is subject to the risk before mentioned.

"It is not alone the mere cost of water power that must be considered, but in a case like this it is the continuance or permanency of the power that will give it its value, and that power will be the most valuable that is liable to the least fluctuation either in quantity or cost.

"I do not think, however, that it will be safe for you to predicate the value of metal produced upon anything short of about $15 per horse power per annum, for 24 hour power, and that in very large quantities, while perhaps $20 per horse power per annum would cover all contingencies."

Taking the estimate of $20 per horse power per annum as sufficient "to cover all contingencies," we would have as the cost of one horse power per hour 0.238 cents (or say about one-fourth of a cent.)

This would give for 22 horse power 5½ cents, and for 22 electrical horse power, allowing 10 per cent. for loss in the conversion, 6 cents. Capt. Hunt allows 5 cents for his power and considering that the figure named by Prof. Sellers is obviously intended to be liberal, I feel entirely satisfied that it is a fair one.

Capt. Hunt's estimate of the capabilities of the electrolytic method of producing aluminum on the largest scale is as follows·

BY THE ELECTROLYTIC METHOD.

COST OF PRODUCING 1 POUND OF ALUMINUM.

2 lbs. alumina (contains 52.04 per cent Al^2) at 3 cents..	.06
1 lb. carbon electrodes, at 2 cents.....	02
Chemicals, carbon dust and pots.....	.01
22 E. H. P. for 1 hour (water power).....	.05
Labor and superintendence.....	.03
General expense, interest and repairs	.03
	$0 20

In presenting, by way of comparison, the possible figures of the metallurgical method, conducted on the same extensive scale and on the lines of my previous comments and explanations, I will assume that the cost of the last two items of the foregoing estimate will be the same, an assumption which may be made with safety. Referring now to the preceding data, we will have

BY THE METALLURGICAL METHOD.

COST OF PRODUCING ONE POUND OF ALUMINUM.

3¼ lbs. Al F6 (containing 32.7 per cent. Al2), at 3 cents.....	.09¾
2½ lbs. sodium at 3¾ cents.....	.09⅜
Labor and superintendence.....	.03
General expenses, interest and repairs.....	.03
	$0.25⅛

I think that I have presented in the foregoing the capabilities of the sodium process within entirely reasonable bounds. I admitt, however, that I have made the best possible showing for the metallurgical side, except in respect of the last two items, in connection with which metallurgical operations should show an appreciable advantage over the electrolytic and may bring the totals of the two estimates practically to an equality.

The fundamental fact that alumina can be reduced to the metallic state by carbon is established. It is proved beyond peradventure by the operation of the electric furnace, in which heat developed by the transformation of electric energy upon the passage of the electric current through a fragmental resistance material of carbon and alumina (with copper or other metal present as a solvent) is believed to be the principal agency in effecting the reduction. The same action may probably take place, to some extent, in the operation of the Herault furnace, and certainly does so, if the statement can be verified that the output of this furnace is greater than can be accounted for by simple electrolytic action.

The reduction of alumina by carbon, therefore, may safely be stated to be simply a problem of temperature, and this temperature is probably not far above the fusion point of alumina. This, unfortunately for the practicability of the direct reduction process lies enormously high—so high, indeed, that it does not admit of instrumental measurement but can only be approximately estimated as somewhere between 2000° and 2600° C.; a point which cannot be reached save by the intervention of electric heating. I will venture a prediction that in the near future the alloys of aluminum will be produced at least as cheaply by chemical methods as by the present electrical methods.

The processes in which electricity is applied either for the direct reduction of aluminum by electrolysis or as the agency for producing the heat required to effect its reduction by chemical reactions, have outstripped the metallurgical methods in the race for supremacy and have taken a decided lead.

Within the past two years the metallurgical processes as represented by the improved methods of Castner, Netto, Grabau, and others of less renown, have been forced to abandon the field to the electrical methods of Hall, Minet, Cowles and Herault.

In one brief lustrum to have overtaken and gained the mastery—though it should prove to be but temporary—over a champion so redoubtable as the chemist who has been striving for the glittering prize through half a century of toilsome progress and indifferent success, is an achievement of which the electrician may well be proud. It behooves him, though, to look well to his freshly-earned laurels, for his victory will stimulate his rival to renewed exertions.

But let our sympathies incline this side or that, if the outcome shall be—and I am persuaded it will speedily be—the final solution of the aluminum problem, we may rejoice in common, for in the victories of peace the vanquished share with the victors in the spoils of the battle.

[1] Abstract of a paper read before the American Institute Electrical Engineers, May 21, 1891.

[2] Richards. The Aluminum Problem. *Jour. Frank. Inst.*, March, 1891.

Frankfort Electrical Exhibition.

Details of the electrical exhibition, now in progress in Frankfort, Germany, are obtainable from the *Offizielle Ausstellungs Zeitung*, or official journal, of which several numbers have already appeared.

The enterprise was initiated on November 30, 1889, at a meeting of members of the Electro-technical society and other corporations of Frankfort. Dr. Adickes, mayor of Frankfort, and Dr. Miquel, minister of finance, have been elected honorary presidents. Dr. Werner von Siemens of Berlin, Dr. A. von Waltenhofen of Vienna, Thomas A. Edison of New York, Marcel Deprez of Paris and Dr. Silvanus P. Thompson of London were chosen as honorary members. The executive council consists of L. Sonnemann, O. von Miller, C. Stiebel, and A. Horkheimer.

The ground plan of the exhibition comprises a considerable area, reaching from the central railway station to the Gallus-Anlage, a distance of nearly one-third of a mile, the principal boundary lines being the Kaiserstrasse and Gutleutstrasse, both diverging from the Gallus-Anlage. The exhibits are divided into the following 12 groups:

I. Steam, air and gas motors.
II. Production of electric energy.
III. Distribution of electric energy.
IV. Accumulators and transformers.
V. Electric transmision of power.
VI. Electric lighting in all its branches.
VII. Telegraphy and telephony.
VIII. Electric signaling with its various applications.
IX. Electro-metallurgy and electrolysis.
X. Measuring instruments and scientific apparatus
XI. Application of electricity for medical and surgical purposes.
XII. Electrical literature.

Out of 77,000 square meters area inclosed by the exhibition fences, 3,000 are occupied by the large machinery hall, which has a frontage of 27 meters, a length of 127.6 meters, and is 17 meters high the center cupola reaches to a height of 40 meters. Twenty steam boilers of a collective capacity of upward of 3,000 horse-power supply steam for the sixty engines of different types, the largest of which is a triple expansion engine of 500 horse power. In addition to these are a number of gas engines, some actuated by ordinary illuminating gas, and others by Dowson gas generated on the spot. A considerable portion of this power is applied to driving dynamos of different descriptions, from the smallest laboratory apparatus up to machines taking 300, 500 and 600 horse power.

Various kinds of accumulators form part of the installation, and these require about 400 horse power for continuous charging.

Electric motors, continuous and alternating current, will be used for almost every conceivable industrial purpose, as well as for driving all the machinery in the "model mine."

Among the novelties in Group IX. will be found a new process of electro-plating plaster cast figures, giving them the appearance of solid bronze.

Remarkable Telegraph Circuit.

According to George F. Jones of New York the most remarkable telegraphic circuit ever made was the one rigged up two years ago between Victoria, B. C., and London. "It was the longest continuous circuit ever run together," he says, "and covered over one-third of the earth. The occasion of it was a prolonged interview between Editor Stead of the *Pall Mall Gazette*, and Henry Norman, a correspondent of that paper making a tour around the world. The facilities for that talk were furnished by the Canadian Pacific Telegraph company and the Commercial Cable company. Mr. Stead sat at a key in his newspaper office in London, and Mr. Norman stood beside an operator in the telegraph office at Victoria. The conversation continued for twelve hours. The exact distances traversed by the circuit on this occasion were as follows: Vancouver (B. C.) to Montreal, 2,900 miles; Montreal to New York, 500 miles; New York to Cape Canso, 1,000 miles; Canso to London, 2,600. Total, 8,200. This is the longest circuit ever worked and is the greatest feat yet accomplished in telegraphy. The wire outstripped the sun by nearly eight hours, it being 1 o'clock in the afternoon at Vancouver when it was 9 o'clock at night in London. The conversation began at 9:07:30 P. M. London time and ended at 12:11:30 A. M. same standard. The average time occupied in asking a question and receiving a reply, if not lengthy, was half a minute. Mr. Norman was about to embark for China and Japan on his tour around the world, and could see the Pacific ocean and his steamer from where he sat talking with his chief. During the interview all the prominent local officials and editors along the line exchanged greetings with Editor Stead and his able representative."

Advancement of the Electric Railway.

It is estimated that there are not less than 325 electric roads in the United States, England, Germany, Italy, Australia and Japan, requiring over 4,000 cars and 7,000 motors, with 2,600 miles of track, with a daily mileage of not less than 400,000 miles, and carrying 750,000,000 passengers annually. Grades of 13 and 14 per cent., distances of six miles or more from the central stations, speeds as high as from twenty-five to thirty miles per hour for single cars and trains of from two to four cars, characterize their operation. Not less than 10,000 persons represent the number employed on these roads. Fifty millions of capital invested in this country alone and a present annual business not less than $8,000,000 to $10,000,000 on the part of the manufacturing and contracting electrical companie, show the present standing of the street railway works.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 30.—The cable has already begun to play unpleasant pranks and the people who depend upon it are beginning to realize that the stories from other cities similarly afflicted were not without foundation. It has a habit of failing at the most critical times, greatly to the inconvenience of the public, and the dismay of the company operating the road. One of these failures happened to-day, when thousands of persons were delayed.

The Board of Electrical Control met Wednesday, all the members being present. Commissioner Storm occupied his seat for the first time. The Mayor expressed disapproval at the failure of the companies to place their wires in conduits with less delay. Commissioner Hess called attention to complaints that had been made by the electrical companies of insufficient subway accommodations, and offered a resolution providing that both the old and new subway construction companies begin work on all subways required before June 15th and complete them before December 31st. This was passed with the understanding that failure to comply with this order would result in forfeiture of the bonds.

Judge Ingraham has refused the Brush Electric Illuminating company's application for a perpetual injunction, restraining the Consolidated Subway company from removing the cables and conductors of the plaintiff company from the subways, and for an adjudication upon the just and reasonable rental to be paid for the use of the subways.

The topics of interest among electrical people are the incandescent lamp suit and the report of the Rapid Transit commission. Electrical engineers are of course elated over the advance indicated in the report. W. H. T.

San Francisco, Cal.

SAN FRANCISCO, May 26.—The Union Power company of Portland, Ore, has secured a location for its power house at the North Pacific lumbering mills. It will at once begin the construction of a power house with a capacity of 3,000 horse power. This will supply all the power needed to run the electric railways in Portland, and also to supply power to stationary motors. The company will deliver 1,000 electrical horse power at 500 volts to an electric railway situated 15,000 feet from the generators. The copper required will cost in the neighborhood of $50,000. It is reported that six No. 20 Edison generators have been purchased for the plant.

An electric light and water company has been organized at Gallup, near Albuquerque, New Mexico. The incorporators are W. F. Kuckenbecker, E. A. Sawyer, J. J. Keegan, Alexander Bowie, T. N. Hinch, W. A. Maxwell of Gallup, W. B. Childers, Ernest Meyers, ann E. W. Dobson of Albuquerque, Arnold Beecher of Chicago and Jacob Boehm of Denver. The object of the company is to furnish electric lights and water for the town of Gallup, which is a large coal mining camp with at least 2,000 people.

The Transcontinental Street Railway company of Portland, Ore., recently ordered twenty-five cars of the Pullman company. The proposed plant will consist of a complete electrical equipment for these cars, each of which is to be furnished with 15 horse power single reduction motors. The new cars are to be furnished with double trucks, made by the McGuire Manufacturing company. The work of putting up the poles, stringing the wires and connecting the rails of the system will be begun as soon as the material, which has been ordered from the East, arrives. It is expected that the road will be in running order and the power house completed in time to operate it by electricity by the opening of the Industrial Exposition in October next.

The Centralia, Wash, electric light plant has been sold by the Thomson-Houston company to C. B. Hawley of Tacoma, who is at present connected with the Tacoma Light & Water company, and who took possession on May 1st. He will at once put in a 150 horse power engine, and otherwise improve the present service, increasing the number of incandescent and arc lights.

The town of Monterey, the oldest settlement in California, and San Francisco's favorite summer resort, will be lighted by electricity. The Monterey Electric Light & Power company propose to celebrate the event by a so-called "electrical ball" at Bagby's Opera House. Six hundred invitations have been issued, and the affair promises to be one of the finest ever held in California's ancient capital. The plant is the Edison three-wire system of 400 lights' capacity.

The first car was run over the Oakland & Berkeley Rapid Transit company's new line last Friday. The Sprague system is used, and the cars are 32 feet in length, of the open and closed combination type. The road is about fourteen miles long.

A good story, alleged to hail from Reno, Nevada, is going the rounds in electrical circles here The proverbial hayseed who blows out the gas stopped at a Reno hotel one night, and before retiring nearly extirpated a lung in the endeavor to blow out the incandescent lamp. Failing in this he sought to choke off the oil that must, he thought, run down the tube, and the lamp cord, tightly knotted in a dozen places, bears silent witness of his unrewarded endeavors. He then compromised matters by "letting the blamed thing burn," and paying 50 cents extra next day for an all night light.

The Thomson-Houston company has finished the installation of a large arc and incandescent plant for the United States navy yard at Mare Island. The plant cost about $50,000, and is considered the finest of the kind on the Pacific Coast.

The city of Vallejo, California, is inviting proposals for lighting the city with 30 arc lamps.

A 100 light incandescent plant has just been installed by the Ryland-Robinson Electric company of San Francisco in the Yosemite Hotel, Yosemite Valley, Cal. A Wenstrom dynamo is used, and power is obtained from a No. 5 Pelton water wheel, under a head of 168 feet. In making this installation it was found advisable to place the dynamo about 100 feet or so down a steep out-of-the-way canyon, and the question how to get the machine down there at once arose. A jocular suggestion that the armature and fields be tumbled down the embankment through the brush received serious consideration. The binding posts were removed from the field frame, and it was rolled down the hill, closely followed by the armature. Neither were injured in the slightest by their remarkable trip.

The order recently passed by the Board of Supervisors prohibiting the erection of overhead electric railway circuits within prescribed limits in San Francisco may possibly be rescinded, as that body is considering a resolution recently introduced granting the San Francisco & San Mateo Railroad company permission to maintain its poles already erected, and to erect such others as may be necessary to operate the proposed road by the overhead system as projected. A special meeting for the consideration of the matter was held last evening, when the representatives of the overhead and storage battery systems appeared and respectively endeavored to convince the supervisors of the safety or the hazards of overhead construction. At a late hour the session was adjourned until Tuesday evening next. Meanwhile work on the San Mateo road is progressing rapidly, and the new enterprise is not wanting financial support. The Sunny Side Land company has voted a cash bonus of $37,500 to run the main line through Sunny Side tract. Others have agreed with the company to give $28,300 bonus for running its main line through the Lakeview tract, and the fact that the California Trust company guarantees $1,100,000 in 20 years six per cent. bonds is sufficient evidence of the good faith of the projectors.

The lines of the Oakland & Berkeley Electric Railway company, which started last week, are carrying phenomenally large loads, and the big combination 32-foot cars are always filled to their utmost. Being the first electric road ever operated in the immediate vicinity of San Francisco, it has been a great novelty to thousands, who have patronized the road out of curiosity. Nevertheless the success of the system is assured, and the company proposes to extend its system by the equipment of a crosstown road. The receipts of the Telegraph avenue and Berkeley horse car line, which is paralleled by the new electric road, have fallen off to such an extent that its owners propose to change their equipment to an electric system in the hope that they may again hold a paying property. Another proposed electric line for Oakland, known as the Vandercook-Sessions electric railroad, will cross the Eighth street bridge, and run out across town to East Oakland. An official of the company states that they hope to commence work within two months, and that the road will then be pushed to completion.

At a meeting held in Santa Cruz on the 20th inst. the Santa Cruz, Garfield Park & Capitola Electric Railway company was organized with a capital stock of $100,000. A bonus of $20,000 will be required, of which sum $13,000 has been subscribed.

The Board of Trustees of Redwood City, Cal., has issued a call for an election to determine on the bonding of the town for $45,000 for public improvements, consisting mainly of an electric lighting system. The town now owns its own waterworks, is out of debt and its officials desire to own the lighting system.

James Price and James Joyce were at work in a field at Arroyo Grande, Cal., last week when they were struck by lightning, Joyce being killed outright, and Price being seriously but not fatally injured. Such an accident is almost unheard of in this state.

The contract for wiring the new ten-story Crocker building for 1,700 lights has been awarded to the Edison General Electric company. S.

Kansas City, Mo.

KANSAS CITY, Mo., May 30.—The indications are that Kansas City will soon have another electric street railway. The preliminary work for it is now in progress. Petitions for signers and for the right of way are being circulated. As soon as these are completed the city council will be asked for a franchise. The proposed road is to start at Second and Wyandotte streets. It will run south on Wyandotte street to Twenty-seventh, where it will turn west to Central street. On Central it will run directly south to the suburb of Roanoke, which will be the southern terminus. In addition to this a branch line is projected from Seventeenth and Wyandotte streets to run east and connect with the Ivanhoe Park electric line on Vine street. The Ivanhoe Park line is owned and operated by the Thomson Houston company. This fact would seem to indicate that the same company is interested in the proposed new line, and that its system will probably be adopted if it is built.

The Kansas City, Fort Scott & Memphis Railway company now has a telephone exchange of its own in its general office building in this city. Any officer can carry on a conversation with any other person in the building absolutely secure from outside interference and danger of being overheard. The exchange has no bells. Press buttons and falling shields are used instead. The instruments in the offices are movable, and conversations may be carried on in almost a whisper.

Gerald W. Hart, who has for the past four years been actively connected with the electric lighting interests of Kansas City as superintendent of the Edison Electric Light & Power company and assistant general manager of the Kansas City Electric Light company, was recently presented a handsome gold watch by the employes of the two companies named. Mr. Hart severed his connection with the companies on April 1st in order to devote his whole time to the interests of the Hart & Hegeman Manufacturing company, in which he is associated with G. S. Hegeman, also formerly of the Edison Electric Light & Power company. The business of the company is the manufacture of special electric light supplies. Mr. Hart was the first man the Thomson Houston Electric company employed when it first started in business in 1880 in New Britain, Conn. In 1887 he came to Kansas City to accept the positions which he has just now relinquished. In 1882 he installed the plant of the Kansas City Electric Light company, the first station anywhere established using the Thomson-Houston system. Mr. Hart has left for New York, where his company will be located.

The Atchison, Topeka & Santa Fe Railway company has taken the initial step toward carrying out the project conceived several years ago of building at Morris, Kan., ten miles west of this city, a large manufacturing suburb. This step consists of taking out a charter for the Quivera Dam and Electric Power company, all the officers and directors of which are stockholders in the Santa Fe, and many of whom are directors of the road. The object of the company is to construct a dam in the Kaw river at Morris and to convert the water power into electrical power, light, heat, etc.

At an early date the Inter-state Water & Electric Power company of Kansas City, Kan, will file with the register of deeds an abstract of the riparian rights secured by that company on and along the Kaw river west of the city. This means that the great project of the company is to be carried out. The company proposes to convert the water power of the river into electric power, heat and light, which is to be accomplished by the building of a huge dam and the establishment of large electrical works. A complete survey of the project was made last fall by engineers from the East, who reported most favorably to the proposed eastern stockholders.

The court of appeals has recently decided that a person is entitled to damages against a telegraph company for a delay in the delivery of a message, whether the claim for damages is made within the limited sixty days or not. The limit is fixed by the statutes in case a penalty is to be inflicted on the company for neglect. The court also decided that a telegraph company was liable for damages for revealing the contents of a message to any other person than he to whom it was addressed, no matter what the nature of the message.

Vice-President Robert C. Clowry, C. H. Summers, T. T. Eckert, Jr., son of General Manager Eckert, and M. C. Bristol, all of Chicago, with the exception of Mr. Eckert whose home is in New York, were in the city this

week on a tour of general inspection of the Western Union, and left on their way through to the coast.

Trial trips have been made over the West Side electric line in Kansas City, Kan., and have proved successful, and as soon as the litigation over one crossing has been settled, the road will begin regular operations. The road has been constructed in just fifty-nine days, and that with bad weather and other things to cause vexatious delays. The engine and generators have been given adequate tests, and proved perfect. The engine is a 150 horse power Williams compound, and is said to be the first ever set up in either Kansas City. P.

Pittsburg, Pa.

PITTSBURG, May 30.—A bill in equity was filed the other day by the Thomson-Houston Electric Light company and the Thomson-Houston Electric company, of Boston, against the Hughes-Gawthrop company of this city. The latter was the local agent of the Thomson-Houston company. The defendant, it is stated, was organized with a capital stock of $25,000. Its assets amount to $48,000, and its liabilities to over $79,000. The plaintiffs are creditors to the extent of $39,000, of which the local company holds $24,000 and the parent company $15,000. The defendants, they allege, are unable to pay the indebtedness, and intend to confess judgment to Paul H. Hacke, the president of the company, or some one in his interest, for $21,000. An injunction is asked for in the bill to restrain them from selling or assigning their property or confessing any judgment, and to have a receiver appointed to take charge of the affairs of the company.

The Troy Hill branch of the Pleasant Valley Electric Street Car company was opened this morning for operation. The line runs from the Postoffice building in this city to the Allegheny City Line on Troy Hill, a distance of five miles.

A party of German capitalists from Bremen, Hamburg and Cologne passed through this city a few days ago on an American tour, inspecting electric street railroad systems operated in this country. They left here on Tuesday morning on their way to Cleveland, O.

Arthur Hartwell, one of the electricians of the Westinghouse Electric & Manufacturing company, has just returned from Portland, Ore., where he has been staying for the last six months, engaged with the Willamette Falls Electric company. E. H. H.

Denver, Colo.

DENVER, May 30.—About two months ago a company was incorporated to furnish electric light for North Denver and Highlands; but in case a franchise is obtained from the city council operations will be undertaken on a larger scale. This will also give the city an opportunity to secure lower rates for street lighting.

Work has been begun on the Denver consolidated Electric company's additional plant. It will have a capacity of 1,200 arc lamps and 12,000 incandescent lights.

The Denver & Suburban company is hurrying the construction of its line.

Work on the new electric line to connect Denver and Highlands will be begun at once.

South Denver was illuminated by electric lights a few days ago. The South Denver Electric Light & Power company has recently placed an $80,000 plant in that suburb, and has about thirty miles of wire strung.

The Berkeley motor line is being changed to an electric road.

C. M. Davis, electrician for the Pueblo street railway company, has resigned his position to accept one with the Edison Light company in Denver. The Citizens' Electric company of Pueblo, to furnish electricity for lighting, heating and power in that city, has filed articles of incorporation with the secretary of state. The promoters of the enterprise are John F. Vail, C. H. Lamkin, and F. H. Devine, and the capital stock is $100,000.

The Gonyard Electric company of Denver with the object of operating the Gonyard electro-magnetic process for the treatment of low grade ores and carrying on a general electric business has filed articles of incorporation. The capital stock is $100,000, and the incorporators are Gustave M. Gonyard, John C. Watson and Albert G. Hood.

Downs & Ashton have secured the contract for the erection of the power house of the Denver Suburban railroad. The building is to cost $20,000 and is to contain three 100 horse power engines.

The stockholders of the Pueblo Electric Railway company met last week and elected the following officers: B. M. Wilson, president; W. A. Moses, vice-president; J. R. Dixon, secretary; George J. Danbaugh, treasurer; J. P. Vail, general manager. It will push the work of construction as soon as material can be secured from the East.

The Canyon Traction, Light, Power & Land Improvement company, with a capital of $1,500,000, is a new organization at Canyon City, Colo. One of the objects of the company is to build an electric line in Canyon City The officers are A R. Black, president; B. B. Schock, secretary, and J. H. Harrison, treasurer. E. C. D.

Nashville, Tenn.

NASHVILLE, May 30.—A great activity has prevailed in the extension of electrical enterprises in this city since January 1st. Almost every session of the city council during this year has been distinguished by the consideration of weighty matters of rights of way, charters, franchises, etc. One company appears disposed to deny to the other companies the right to use the earth for return currents, but this dispute has not got into the courts yet. The conditions are all favorable, however, for a rapid and continuous extension of the business. Since the compromise between the United Electric and the Maplewood railway companies, work upon the latter line is being vigorously pushed. It is now given out that the Maplewood company is to construct and equip the line and that the United Electric company is to operate and keep it in repair under a guarantee from the former that the receipts shall fully cover operating expenses.

The Shelby avenue extension has nearly been completed, and the United Electric company began May 1st to run its cars from the Fatherland street line south along Tenth street to Shelby avenue and east on Shelby beyond the city limits.

The Electric Railway & Power company ran a trial car over its lines on May 1st.

The installation of the new electric light plant at the shops of the Nashville, Chattanooga & St. Louis Railroad company has been completed. This is one of the largest isolated light plants in the South.

The United Electric railway has now 90 miles of track, with 56 motors in daily operation, supplied by nine generators of a total capacity of 770 electrical horse power. During the races it handled 5,000 people in thirty minutes every day for eleven days.

The Citizens' Rapid Transit line now runs to West Nashville, a distance of three and one-half miles, using three cars of the Sprague type. This company has an 80 horse power Allis Corliss engine and a No. 20 Edison generator, and is doing fairly well. The Cumberland Telephone & Telegraph company is improving its system considerably by stringing on Cherry and Church streets lead covered cables, which take the place of many wires.

The new shops of the Nashville, Chattanooga & St. Louis Railway company are now lighted by incandescent and arc lights run by an 80 horse power Dick & Church engine. B.

Toledo, O.

TOLEDO, May 30.—This city will soon have one of the most complete systems of electric street railways in the country. A little over a year ago a syndicate, composed of Chicago capitalists, bought all the horse car lines in the city, and reorganized them, calling the new company the Toledo Consolidated Street Railroad company; N. B. Ream president, and W. E. Hale, secretary, both of Chicago, and A E. Lang of Toledo, general manager.

This was followed by another syndicate, composed of Toledo capitalists, proposing to build and operate an electric road, the name of which is the Toledo Electric Street Railway company, more commonly known as the "Robisons," as David Robison, Jr., & Son, are the principal owners and operators.

The two companies have fought desperately in the courts for a year, and the end is not yet.

Summit street being the principal thoroughfare, the Robisons have endeavored to obtain the right to use the Consolidated company's tracks on Adams, Summit, Monroe and Ottawa streets as a connecting link to their lines. They succeeded in stringing wires over the Consolidated company's tracks Sunday and Sunday night, and now they own the wires, while the Consolidated company owns the tracks, and each is prohibited from using the other's property.

The Consolidated company has changed many of the lines to electric, and expects to have them all running by electricity at an early day, but cannot use the Robisons wires, and the city will not allow two sets of wires to be placed in one street.

A decision was rendered in the Probate Court giving the Robisons the right to use the Consolidated tracks on Adams street, from Ontario to Summit, a distance of six blocks, by paying the sum of $17,376.46. The Consolidated company refused to accept the money, which now remains on deposit.

Judge Millard of the Circuit Court, after studying over the question of the necessity for the condemnation of Summit, Monroe and Ottawa streets, arrived at a decision in favor of the Robisons. This decision he intimated to the lawyers, but gave no reason for the judgment. The decision is intimated in advance because the bill of exceptions must be presented when the judgment is given, or the right to take the case to the Common Pleas court is debarred.

This petition in error will be more than twice as voluminous as in the Adams street case, which was the largest petition in error that ever went up in any Probate Court.

This decision gives the Robisons the right to go over the streets desired unless the jury fixes the compensation so high that the Toledo Electric Street Railway company cannot cover it.

They are willing to settle on the same basis as on Adams street. Barton Smith, one of the attorneys for the Consolidated line, in speaking of the case, said: "There are three things bound to be settled in the courts; first, the right of a company to use any motive power desired; second, provisions for the renewal of the track; and third, regulations for the joint use of the tracks. There will be constant friction until these points are settled."

The prospects seem very favorable just now for the proposed electric railway to run from Toledo to Perrysburg, a distance of nine miles up the Maumee river. It is proposed to go up on one side of the river and down on the other side, taking in the town of Maumee and the beautiful scenery along the entire line.

Toledo now has a most complete system of electric lighting, having an arc lamp at each street intersection hung in the middle of the roadway. The blocks are usually short. F. C. H.

Detroit, Mich.

DETROIT, May 30.—A franchise for a street railway has been granted by the town board of Hamtramck, extending from the Detroit city limits to Leesville, a distance of about six miles. The town board will select the kind of motor to be used.

The Detroit exposition managers are busy planning for a great exhibition of electrical inventions next fall. The display is intended to be on a grand scale, and to occupy the whole of the art hall and all necessary space on the exposition grounds. It will include all the marvels of modern electrical inventions.

A. B. Glover of the Ann Arbor electric railway and the Ypsilanti & Ann Arbor motor line, was in Detroit this week.

A new electric light company has been organized in Windsor (opposite Detroit), and will make application for incorporation at once. The incorporators are Aldermen Nash and Sutherland and W. C. Turner. The name of the new company will be the Windsor Electric Light & Power company; capital, $25,000. Work is to be pushed as rapidly as possible, and it is thought by the directors that current will be turned on by July 1st.

The Ann Arbor Electric Railway company is having trouble in building an extension. Several residents along the line asked for an injunction restraining the company. The courts refused the injunction, but poles and guy wires had been cut, and it was found necessary to guard the line.

The Bay City board of electric control has passed an ordinance that the street railway companies must erect iron poles to support their trolley wires, and widen the distance between tracks to six feet.

There is no doubt that all the street car companies here are contemplating a change in motive power. The City Railway company has been experimenting with the Healey steam motor, and is still using it on its lines occasionally.

The horse car lines at Battle Creek are to be changed to electric lines, and the tracks extended about four miles.

The South Haven city authorities have given S. H. and G. F. Harrison of Paw Paw permission to run an electric light plant in South Haven for ten years.

A Western Union lineman received a severe shock from an electric light wire he was trying to fix at Fort Gratiot. His horse was killed by the wire falling on it.

The Fort street company is considering electricity as a motive power, and has conferred with representatives of several electric companies with a view of installing a plant. G.

J. C. Henry of San Diego, Cal., suggests a novel means of testing the condition of horses' feet. Attach one terminal of a light battery to the animal's bit, the other to the shoe. If the horse suffers from the shoe or nails, he will squirm under the test. If there be no irritation he will pay no attention to it.

PERSONAL.

Charles J. Van Depoele was in Chicago last week.

W. L. Adams, well known in engineering circles, is now with the Electric Merchandise company, Chicago, representing the company in the East.

A telegram from Washington reports the resignation of Charles E. Mitchell, the commissioner of patents. He will retire June 30th, according to this authority.

William S. Turner of Brooklyn and Helen Sewell were married at Clarinda, Ia., May 19th. Mr. Turner is president of the Woodbridge & Turner Engineering company of New York city.

Frederick Sargent, consulting electrician to the Department of Construction of the World's Columbian Exposition, has formed a copartnership with A. D. Lundy, at present chief electrical engineer for the southern district of the Edison General Electric company, with headquarters at Atlanta. Mr. Lundy is an experienced electrician. He was engaged on the first electrical street railway in the country in Richmond, Va. He will arrive in Chicago June 10th.

NEW INCORPORATIONS.

Rocky Mountain Electric Light & Supply company, Butte City, Mont.; capital stock, $50,000; sale of electrical supplies.

Portland Electric Light & Power company, Portland, Mich.; capital stock, $10,000; to supply light, heat and power by electricity.

Hastings Electric Light & Power company, Hastings, Mich.; capital stock, $15,000; to supply Hastings with electric light and power.

Bath Electric Light & Power company, Bath, N. Y.; capital stock, $25,000; manufacturing and using electricity for light, heat and power.

Elkton Canning & Evaporating company, Elkton, Va.; capital stock, $30,000; canning fruits, etc; real estate, building street car, gas and electric works.

Martinsville Electric Light & Power company, Martinsville, Ind.; capital stock, $9,000, to manufacture and furnish electricity for light, heat and power at the city of Martinsville, Ind.

Rocky Mountain Electric Power & Supply company, Butte, Mont.; capital stock, $50,000; furnishing electric light and power, steam heat, and dealing in electrical apparatus and supplies.

Rogers Park Light, Heat & Power company, Rogers Park, Ill.; capital stock, $75,000; to build, maintain and operate gas and electric plants, etc., and to supply gas and electricity for light, heat and power.

ELECTRIC LIGHTING.

An electric light plant will soon be established in Watkins, N. Y.

It is expected that an electric light plant will be established at once at Athens, Tenn.

Elyria, Ill, has introduced the electric light. Sixty-five arc lamps are used on the streets.

A stock company will probably be organized at Convers, Ga., to establish an electric light plant.

The Anniston, Ala., Gas & Light company will install additional machinery in its electric light plant.

The city council of Harlan, Ia., has awarded the contract for an electric lighting plant to the Edison General Electric company.

The people of Lachine, Quebec, have decided to introduce electric lighting, and A. J. Corriveau has contracted to establish a plant.

Wheeling, W. Va., will hold a popular election to determine whether it shall issue $80,000 of bonds for the erection of an electric light plant.

The city council of Paris, Tex., has contracted for the supplying of the city with electric lights; a plant costing about $20,000 will soon be erected.

The citizens of Paris, Tenn., have petitioned the city council for the holding of an election to vote on the issue of bonds for the purpose of establishing an electric light plant.

Despite the political troubles in which the country is plunged, it is evident that Bulgaria is paying considerable attention to modern improvements, as the municipal authorities of Sofia have advertised for bids for an electric light installation. The time for receiving such proposals expires on July 13th.

Manistee, Mich., boasts of two arc lighting plants established since last Christmas. One of them is a Brush plant operating 110 lights. Two 65 light machines and one 30 light, driven by Ide and Ideal engines, comprise the plant. In the second plant there are three 30 light Western Electric company generators driven by Phœnix engines. The Brush plant will be doubled shortly and a Corliss engine used.

An extensive scheme for the generation of electricity by water power is under consideration in Melbourne. It is proposed to utilize the power of the Garra river at waterfalls, respectively eleven and sixteen miles from the center of the city. The works will cost about $600,000, and it is estimated that 50,000 incandescent lamps could be operated in times of the lowest water, while in the winter season 450,000 could be supplied.

When the plans of the new Consumers' Electric Lighting & Power company of St. Louis are executed, it will have one of the largest stations in the Southwest. The company, which has a capital of $750,000, will establish a plant on the southeast corner of Levee and Morgan streets. The building will be 100 by 150 feet, and five stories high. The machinery for the station is being manufactured, and the plant is to be sufficient to operate 1,500 arc and 15,000 incandescent lights.

The Denver, Colo., Consolidated Electric company is preparing plans for increasing the capacity of the West Denver station. The cost of the contemplated improvements, for the greater part of which the contracts have already been let, amounts to $150,000. The company, which has been in operation since August 19, 1881, has now in operation 1,500 arc lights, 1,200 municipal street incandescent and 40,000 commercial incandescent lights, and motor service of 100 horse power.

ELECTRIC RAILWAYS.

It is said that an electric railroad thirty miles long, costing $400,000, is to be built in Siam.

The Houston, Tex., Rapid Transit company has secured a franchise to build twelve miles of electrical railroad.

The Charlottesville, Va., & University Street Railway company expects to adopt electricity as the motive power.

The Eureka Springs, Ark., Electric Light & Street Railway company will probably construct an electrical railroad.

The owners of the Oakland, Cal., and Berkeley rapid transit road contemplate bonding the property for $500,000.

The Rapid Transit Railway company of Baltimore will probably operate several branch lines by the storage battery system.

It is probable that an electric road will be built this year from Lester Park to West Duluth, Minn., a distance of twelve miles.

The Thomson-Houston system will be adopted for the Quincy, Mass., electric freight railroad. This road will be principally used for the transportation of granite.

The Belt Electric Railway company of Los Angeles, Cal., has purchased the Los Angeles and Vernon street railway line, which will be run in connection with the main system.

The trolley system as tried at Syracuse has resulted in unequivocal success, according to the *Standard* of that city, which states that many capitalists and the officials of numerous cities have inspected it.

The Paterson Railway company of Paterson, N. J., and the Passaic, Garfield & Clifton Electric Railroad company have been consolidated. The Paterson Railway company absorbed the other, and the new company will be known by that name.

The town of Spardau, in Germany, has granted a concession to a Boston firm for the construction and operation of two electric railways within the limits. The concession is to last for fifty years, the town to receive a percentage of the profits of both roads.

The Metropolitan Trust company of New York has begun mortgage foreclosure proceedings against the Topeka Rapid Transit company, owner of the extensive electric street railway system in Topeka, Kan., and suburbs, for the Thomson-Houston Electric company. The Thomson-Houston company owns $185,000 of the $324,000 of mortgage bonds. The court has been asked to appoint a receiver.

The Worcester, Leicester & Spencer Electric railway is the name of a new road which is to run from the city hall, Worcester, through Valley Falls, Cherry Valley, Leicester to the town hall in Spencer, Mass. The entire distance is about thirteen miles, and the road will run through a well populated district. The road equipment will consist of ten motor and six trail cars, which, it is expected, will be in operation about the middle of July.

"In Scranton, Pa.," says the *Street Railway Review*, "they delight to call their city, 'The Electric City.' The extension of the electric railway lines to adjoining towns and suburbs has had a most astonishing effect in enlarging the volume of business. Where formerly people came in to trade once in four weeks, now they come regularly twice every week. This practically gives the residents of outlying and cheap property the advantages of the city for trade and amusement. So profitable have the merchants found the additional trade that many of them furnish the transportation both ways for those who come in to trade; while the delivery of goods to neighboring towns by the electric lines has proved a great advance over the old method of horses and delivery wagons."

A syndicate has been organized for the purpose of building an electric railroad connecting St. Louis, Webster and Kirkwood. The company, which is composed of wealthy citizens of St. Louis county, all of whom are large holders of real estate along the proposed line, was organized with a capital stock of $50,000, under the name of the St. Louis Electric Railway & Power company. The proposed route is westwardly along the Manchester Rock road, from an eastern terminus at the intersection of Chouteau avenue and Manchester road to the intersection of the Denny road, thence south to Kirkwood. A branch will also extend over the Rock Hill road from the main line on the Manchester road to Webster Groves. A petition has already been presented to the County Court by the company asking for a franchise for fifty years, and obligating itself to begin work on the road within six months, and to complete it within three years from the date of the granting of the franchise.

ELECTRIC MINING.

The works of the Pittsburg Reduction company, which manufactures aluminum by the electric process, will be removed from Pittsburg to Kensington, on the Allegheny river, about twenty miles above the former city.

The Last Chance concentrator of the Cœur d' Alene country, Idaho, began using its new electric plant last month. The power used is an 18-inch Pelton wheel supplied by water from the mine through a 4-inch pipe with a fall of 685 feet. With a ¾-inch nozzle the wheel revolved at the rate of 1,350 turns per minute, with only one-fourth of the water turned on, 35 incandescent lamps being used. With a full column of water the plant will generate 30 horse power, making 2,600 revolutions per minute. The connections for the drills have not yet been made.

TELEGRAPH.

The Loyalton and Sierra City branches of the Sierra Valley, Cal., telegraph line have been consolidated, and the company has increased its capital stock from $10,000 to $12,000.

The Pacific Telephone & Telegraph company has certified to the board of supervisors of San Francisco that it has expended $53,369.76 in laying underground conduits. The work has only been begun.

Col. J. C. Duff of the Duff Opera company has brought a suit for $7,300 against the Western Union Telegraph company. Mr. Duff's company was playing in Boston in the latter part of last January, and late one night Mr. Duff was notified of an action to be brought against him by the Metropolitan Job Printing company of New York for $1,800. Mr. Duff wrote a message on ordinary letter paper at his hotel and addressed it to his lawyer, Louis Steckler of this city. The message directed the lawyer to negotiate a settlement, but it was delivered to another lawyer of the same name at a different address, who sent it by his office boy to Mr. Duff's lawyer late in the afternoon. In consequence of the delay, Mr. Duff says, he was arrested in Boston at the instance of the Metropolitan Printing company, and had to stay in that city two days longer than he had intended, in order to make a settlement. The blunder of the telegraph company, he says, created considerable confusion in his plans. At that time his "Babes in the Wood" company was playing at Niblo's, and negotiations were pending for a production at Palmer's Theater, and his enforced absence from the city caused much of the alleged damage. The telegraph company's answer to the complaint was served last Monday. Mr. Duff's lawyer holds that, although his client's message was not written on one of the company's blanks, the acceptance of the message imposed upon the company all the ordinary responsibilities of prompt and correct transmission and delivery.

TELEPHONE.

The telephone system in Austria has just received an important extension by the laying of a line from Vienna to Trieste. The two provincial cities, Graz and Laibach, are already in the circuit, and the lines from Fiume and Görz are to be joined to the system.

F. E. Sloat of Brockport, N. Y., has commenced an action against the Bell Telephone company of Buffalo to recover $10,000 damages alleged to have been sustained in consequence of a mistake in a telephone message. Mr. Sloat is the owner of the stallion Cambria Wilkes, a half-brother of Maud S. Recently the animal became sick. A veterinary surgeon in Rochester was sent for and was told to come at once. The message was sent by telephone. In repeating it the operator made "F. E. Sloat" "F. E. Smith," and "Brockport" "Fairport." The doctor went to the latter place and returned, before the mistake was discovered. He arrived at Brockport twelve hours later than he could have reached that place, it is claimed, had there been no mistake. In consequence of this delay, the complaint alleges, an operation became necessary which seriously affected, if it did not destroy, the animal's value. The horse is said to be worth $16,000.

MISCELLANEOUS.

A man was arrested in San Francisco recently, charged with malicious mischief in entering the establishment of the Electric Improvement company and endeavoring to smash a large dynamo. He had formerly been employed by the company, and the act was evidently inspired by malice.

Recently published statistics show that on Jan 1, 1890, there existed in the German Empire, exclusive of Wurtemberg and Bavaria, 2,590 electric light installations, comprising 339,000 incandescent lamps and 2,160 arc lamps. There were also nine installations connected with the electrolytic industry and 16 power transmission plants. Some 86 per cent. of the lighting installations were supplied with continuous currents, 9 per cent. employed alternating currents, and 5 per cent. used both.

In a handsomely illustrated article on "The City of Lynn," by Edwin A. Start in the June number of *New England Magazine*, occurs this reference to the electrical industries of that town: "The advent of the great Thomson-Houston electrical business in 1883, with its large capital, boundless enterprise, and large staff of skilled employes, has much done for Lynn, and will probably gather about it allied industries, becoming a rival of the shoe business, or its superior, in magnitude and importance. Already hopeful Lynn men dream of seeing the city the great electrical center of the country."

R. Meade Bache believes that it is possible to destroy bacteria in water, and even in the human body, by electricity, on which the Philadelphia *Record* remarks: "If to the multiplying uses of electrical energy should be added the power of destroying the germs of disease in drinking

water, and in the bodies of afflicted humanity, it would be a wonderful achievement."

In a recent lecture on "Electric and Magnetic Screening," Sir William Thomson condemned the use of the single wire system of lighting ships by electricity, on the ground that observation has shown it to produce an error in the ship's compass of three to seven degrees, every care being taken. It has been argued that the iron hull protects or screens the compass from the deflecting influence of the current, but Sir William declared that this argument was fallacious. He, therefore, recommends the double wire system for electric lighting on board ship, that is to say, the use of a going and returning wire, except in the unusual case of an alternating current being used.

Electricity has, it seems, been called to the aid of those ingenious rascals who engage in the operation known as "sweating" gold coins. The service of an ordinary battery and some cheap acid is all that is necessary to conduct the operation. The scheme is similar to that employed in plating with gold by electricity. The coin is placed in the fluid and attached to it are wires from the poles of the battery leading to another piece of metal prepared to receive, in the form of plating, the metal to be removed from the coin. The battery being connected, sufficient gold to form a plating is quickly transferred, and, as it is removed uniformly from all parts of the coin, the liability of disfigurement is reduced to a minimum. The only effect is to blur the characters slightly. About fifty cents' worth of gold can be removed in this way from a ten dollar gold piece without exciting the suspicion of the casual observer.

TRADE NEWS.

The Electrical Supply company, Chicago, has secured the general western agency for the Stanley Electric Manufacturing company and will carry a full line of the specialties made by it. The salient features of the Stanley transformers and the Stanley alternating current fan motors are well known. The merit of these specialties combined with the enterprise of the Electrical Supply company will, no doubt, develop an extensive field in this territory.

The Electric Merchandise company, Chicago, celebrated its first "birthday" June 1st, and in honor of the event issued a handsomely engraved card thanking its patrons for the encouragement and support extended during the year. This company has closed a most successful season A year ago when the present organization was effected it succeeded to the business of one of the oldest companies of the kind in the country, and retained practically the same management. The company claims to be the only exclusive electric railway company in the country.

BUSINESS.

House lighting plants, small motors and experimental apparatus are specialties of the Mason Battery Electrical company, 257 Broadway, New York. They are illustrated attractively in the company's new catalogue.

It is claimed for the new storage battery placed on the market by Lloyd & Paxton, 2 Wall street, New York, that it has "distinct advantages over all others in mechanical perfection, light weight, longer life, higher delivery and cheapness."

J. W. Calkins & Son, 356 Rookery, Chicago, have just sold two 500-light Mayo generators to the National Electric Construction company, 6 Calhoun Place, to be used in an extension of the capacity of a central station lighting plant in operation in that section of the city.

The Shaw Electric Crane company will remove its office and works from Milwaukee, Wis., to Muskegon, Mich., before the close of June. New buildings are now being built at Muskegon, and it is expected that everything will be ready for the machinery at the time indicated.

The Ball engine is increasing in popularity with electric lighting companies. Secretary Lyman of the Queen City Electric Light company of Cincinnati, writes that the engines "have always done their duty in a highly satisfactory manner, and we look upon the Ball as one of the best high speed engines." The treasurer of the Naugatuck Electric Light company of Naugatuck, Conn., also writes to express his satisfaction with the Ball engine.

The Central Electric company of Chicago reports a largely increased demand for soldering torches of various kinds. This company carries a large assortment of these goods. The Bain break insulator, marketed by this company, is having a ready sale, and is fast growing in popularity with electric railroad men, who use it for insulating span wires. The electric light companies are also using it quite extensively to insulate suspended arc lamps.

The Page Belting company reports recent sales to the following named firms: Beaumont Furniture & Art Wood Manufacturing company, Beaumont, Tex.; Mohawk Knitting company, Mohawk, N. Y; Pennsylvania Steel company, Sparrows Point, Md.; J. A. Grant & Co., Portland, Me.; National Sewer company, Newport, O.; Forbes, Liddell & Co., Montgomery, Ala.; Electric Forging company, Boston; Des Moines Manufacturing and Supply company, Des Moines, Ia.; McNeil Pipe and Foundry company, Burlington, N. J.; Gaines & Glover, Richmond, Va.; Catasauqua Electric Light and Power company, Catasauqua, Pa.; Edison Electric Illuminating company, Boston; Electric Light and Power company, Ellenburg, Washington; Hampton & Old Point Comfort Railway company. The belt sent to Ellenburg was a very large one—96½ feet long, 24 inches wide, and containing 70,000 pieces of leather.

The Thomson-Houston Electric company reports recent sales made through its western isolated lighting department as follows: Smith Steam Baking company, Kansas City, Mo, 50 light incandescent plant; Wainwright Real Estate company, St. Louis, Mo., 3,000 incandescent lights; Iowa Agricultural College. Ames, Ia., 6 arc light dynamo, 35 light incandescent dynamo, one 1 horse power motor and appurtenances for laboratory use; Cudahy Packing company, Sheffield and North avenues, Chicago, 125 incandescent lights; Carson, Pirie, Scott & Co., Adams and Franklin streets, Chicago, 35 arc light and 400 light incandescent plants; S. S. Badger, Ouray, Colo., 100 incandescent light plant; Central Market company, State and South Water streets, Chicago, 30 arc light plant and 100 light incandescent plant; Chicago City Railway company, 150 light incandescent plant; H. H. Shufeldt & Co., 23 Larrabee street, Chicago, 250 light incandescent dynamo, to increase capacity of plant sold last November.

ELECTRICAL PATENTS.

Issued May 26, 1891.

452,771. Police Signaling Apparatus. Henry A. Chase, Boston, Mass.

452,775. Telephone Receiver. Charles T. Dickson, Cincinnati, O.

The first claim is:

"The combination, in a telephone receiver, of an ear piece adjacent to the diaphragm of the receiver, an air space between the diaphragm of the receiver and the ear piece, an aperture communicating with the air space and transmitting sound to one ear, a tube depending freely from the ear piece, communicating with the air space and having at its free end a second ear piece whereby sound is transmitted to the other ear, the tube being so arranged that the sound waves caused by the vibration of the diaphragm will be admitted to it before passing out of the aperture."

452,780. Incandescent Electric Lamp. Isaac J. Flagg, Clinton, Mass.

452,785. Coin Controlled Annunciating Machine. Harry M. Hamrick, Philadelphia, Pa.

452,795. Electric Motor. Charles J. Kintner, New York, N. Y.

Claim one reads as follows:

"An electric motor having a field magnet core divided at its neutral point, in combination with an armature carried by a shaft having longitudinal movement in its journal bearings and a fan attached to one end of the armature shaft."

452,796. Hollow Braided Lightning Rod. George R. Kress, Pittsburg, Pa.

452,799. Hanger for Incandescent Lamps. James A. Matteson, River Point, R. I.

452,871. Automatic Safety Electric System for Locomotives. Edward Deming, Brooklyn, N. Y.

452,872 Automatic Safety Electric System for Railways. Edward Deming, Brooklyn, N. Y.

The invention relates to a system of electric distribution and mechanism for use on railways and railway trains for the purpose of preventing accidents which happen so often by one train running into another while on the same track and both going either in the same direction with different velocities or in opposite directions, or one being in motion and the other stationary."

452,873. Automatic Electric Safety System for Railway Switches and Draw Bridges. Edward Deming, Brooklyn, N. Y.

452,874. Automatic Electric Safety System for Railway Crossings. Edward Deming, Brooklyn, N. Y.

The object of the invention is to provide a system in which a train will be automatically stopped within a predetermined distance of the crossing when another train is at or near the crossing on another track.

452,875. Multiple Fuse Block. Lorenzo B. Favor, Gloucester, Mass.

452,913. Sextuplex Telegraph, Thomas A. Edison, Menlo Park, N. J.

The object of this invention is to transmit six independent messages over one wire at the same time, three in one direction and three in the opposite direction.

Claim two is:

"In a sextuple-telegraph, the combination, with transmitting keys and means, operating to send the proper currents of three receiving instruments, the first of which responds to reversals in the polarity of the current, the second responds to either of two currents that are above a medium strength, and the third respondsto a current of the greatest strength, or to no current from the transmitting batteries."

452,920. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

Of the twenty claims the seventeenth is given:

"The combination in a car of the axles, a frame supported by the axle boxes and extending between the axles, a motor sustained by said frame, and power transmitting devices between the motor and each axle."

452,921. Electrical Switch-Board. John B. Lyon, Brooklyn, N. Y.

452,931. Electro Mechanical Gong. Frederick W. Cole, Newton, Mass.

452,932. Electro Mechanical Gong. Frederick W. Cole, Newton, Mass.

The first claim is:

"In an electro-mechanical gong, a striking arm or lever, and controlling mechanism therefor, combined with releasing mechanism for said controlling mechanism governed by the armature of an electro magnet, a component part of said releasing mechanism serving as a retractor for the armature."

452,934. Electric Motor or Generator. Walter K. Freeman, Brooklyn, N. Y.

452,935. Electric Motor or Generator. Walter K. Freeman, Brooklyn, N. Y.

452 936. Electric Meter. Walter K Freeman, Brooklyn, N. Y.

The object of this invention is to measure and record by electro mechanical means the current flowing through a given electric circuit.

452,937. Electric Switch. Walter K. Freeman, Brooklyn, N. Y.

452,951. Armature for Dynamo Electric Machines or Motors. Elihu Thomson, Lynn, Mass.

The invention consists in making the armature core of sheets or laminæ of soft iron, which are punched into the desired form, and which sheets have a section or plug removable therefrom in such a way that the conducting coils can be slipped in the opening and upon the magnetizable ring, when the replacement of the plug into its position in the ring restores the contour and magnetic continuity, such plug and core also having such a form that they interlock and oppose centrifugal action, the stronger the centrifugal action the greater being its interlocking effectiveness.

452,955. Electric Transmitting Clock. Henry S. Prentiss, Elizabeth, N. J.

452,956. Synchronizer for Electric Clocks. Henry S. Prentiss, Elizabeth, N. J.

452,983. Grounding Device for Lightning Rods. Cassius M. Radford, East Concord, N. H.

This invention relates more especially to lightning rods, the object of the invention being to provide a suitable ground terminal for lightning rods, which may be readily driven into the ground, and connected to a rod just above the surface,

452,992. Electric Motor for Wheeled Vehicles. Robert S. Dobbie, Jersey City, N. J.

453,000. Electric Connection for Distributing Telephone Lines. William M. Goodridge, Highland Park, Ill.

The object of the invention is to provide at the rear of each switch-board means whereby the connections with the answering jacks may be made in the shop, and for this purpose is provided at the rear of each switch-board a strip containing spring connectors for the different wires of the cable.

453,002. Adjuster for Electric Lamp Reflectors. James E. Hamilton, Chicago, Ill.

453,029. Multiple Cut-out for Electric Distribution Systems. Ernest P. Warner, Chicago, Ill.

The invention consists in the construction whereby several cut-outs may be connected on one side with a common bus bar by means of U spring switches arranged so as to permit of the ready disconnection of any cut-out from the bus bar. In this manner each circuit of lamps would be provided with a cut-out at each point of attachment to the main feeders.

453,031. Electric Motor. Elbridge Baker, Malden, Mass.

453,032. Automatic Electric Switch Mechanism. Harry H. Blades, Detroit, Mich.

453,036. Adjustable Support for Electric Wires. Thos. H. Brady, New Britain, Conn.

453,041. Electric Display Burner for Oil Lamps. William A. Drysdale, Philadelphia, Pa.

453,046. Electrical Safety Switch. George L. Hall, Lowell, Mass.

453,070. Support for Trolley Wires. George K. Wheeler, Chicago, Ill.

The invention consists in a metallic basket or trough adapted to receive the trolley wire, and also adapted to admit the passage of the trolley wheel, and provided with ears which can be bent over the trolley wire after it is placed in the trough, in order to hold the wire in proper contact with the trough, and also provided with means for connecting it to the usual insulator between it and the span wire.

453,093. Trolley Wheel. John Sullivan, Washington, D. C.

453,097. Electric Railway Signal. Willie Cowles Walter, Richmond, Va.

453,100. Insulating Clamp for Span Wires. William E. Baker and Charles H. Macloskie, Boston, Mass.

453,104. Electric Contact Brush. James R. Branch, Richmond, Va.

453,111. Electric Fuse Box. William Edson, Boston, Mass.

453,162. Apparatus for Hardening and Tempering Steel and Iron. Elias E. Ries, Baltimore, Md.

453,163. Method of and Apparatus for Hardening and Tempering Steel and Iron. Elias E. Ries, Baltimore, Md.

453,164. Art of Repairing Metal Structures by the Aid of Electricity. Elias E. Ries, Baltimore, Md.

The first claim is:

"The method of repairing fixed metal structures, which consists in cutting out the defective or objectionable section, and then inserting a new section in place of the old and welding it at both ends electrically to the fixed structure."

453,167. Electric Locomotive or Street Car Motor. Rudolph Eickemeyer, Yonkers, N. Y.

Claim one reads as follows:

"In an electric street car or locomotive, the combination, of driving wheel and axle, a slow speed electric motor having an iron cored armature, field coils which surround and directly polarize the armature, and a shell or casing which surrounds the armature and coil, springs which relieve the motor from strains and shocks imparted from the rails to the axles or driving wheels, and pitmen or links with cranks which directly connect the armature shaft and the driving wheels or axle."

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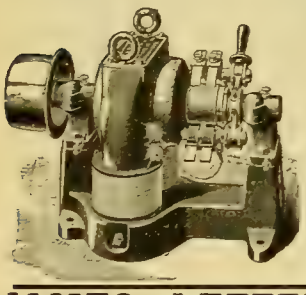

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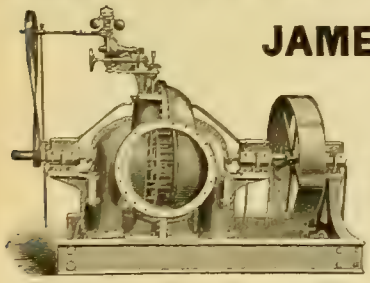

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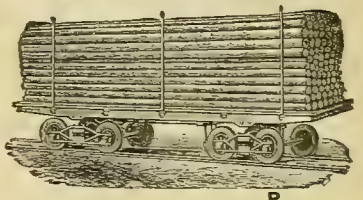

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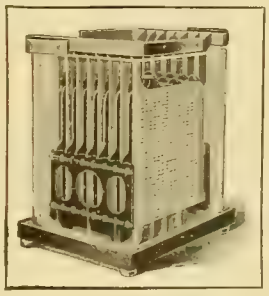

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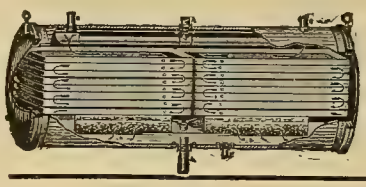

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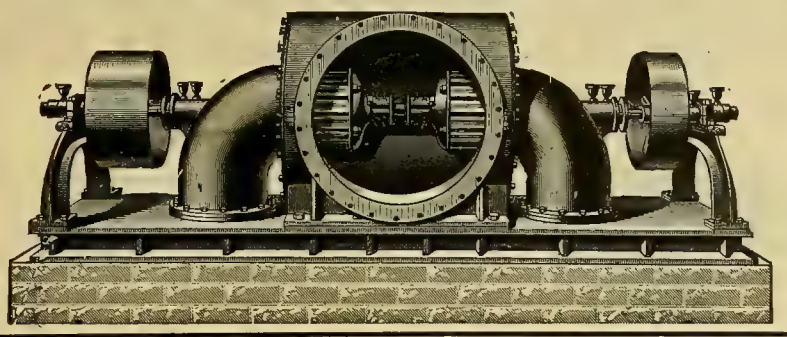

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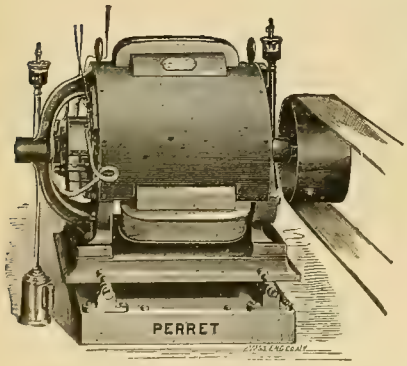

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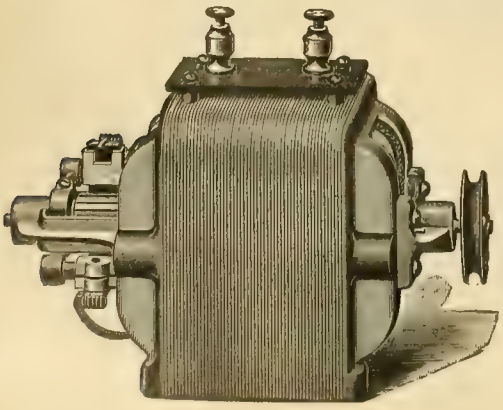

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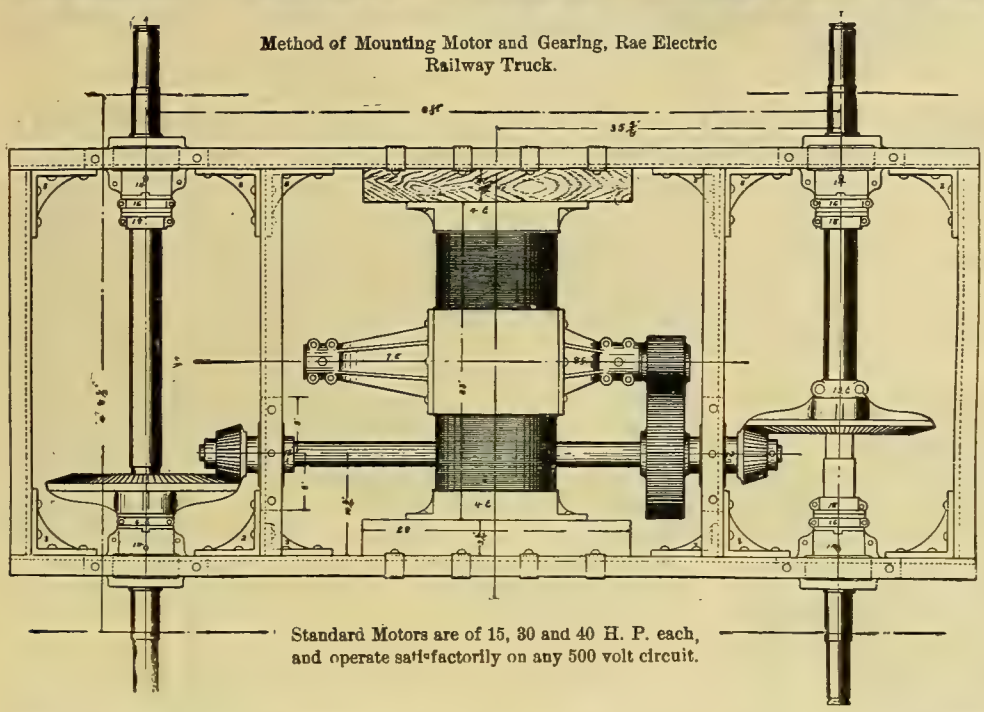

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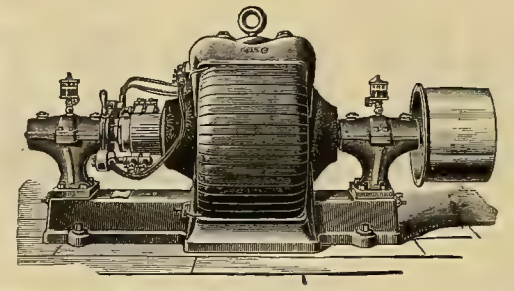

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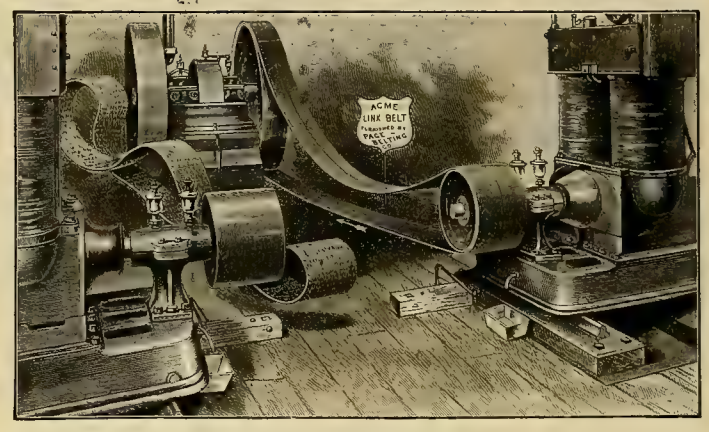

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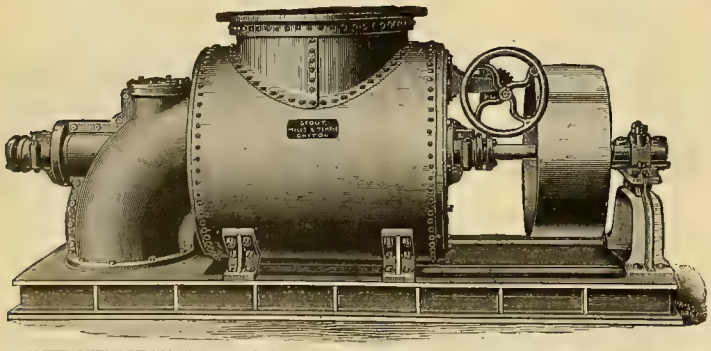

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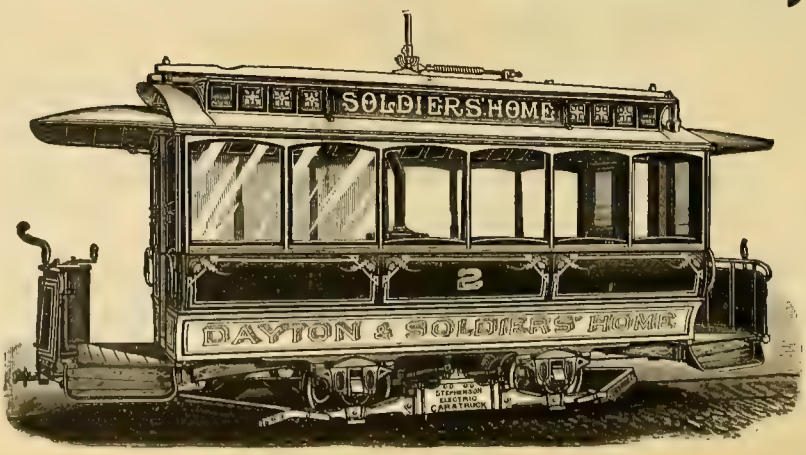

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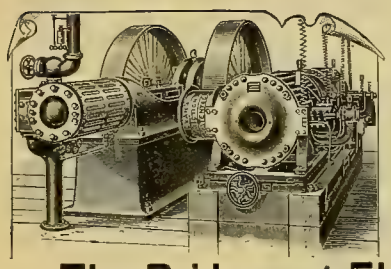
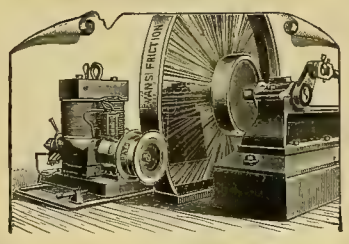
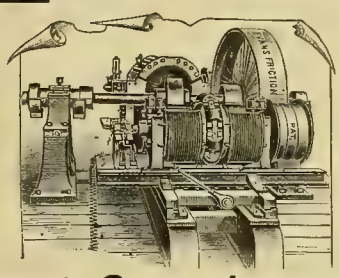
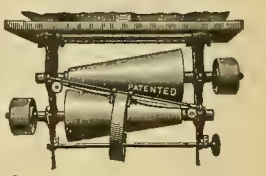

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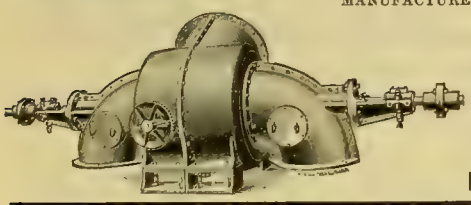

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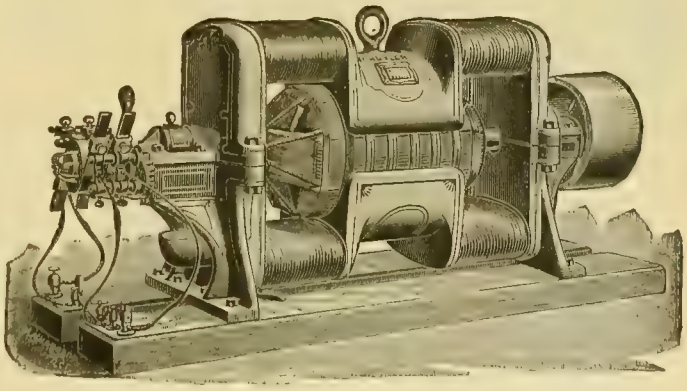

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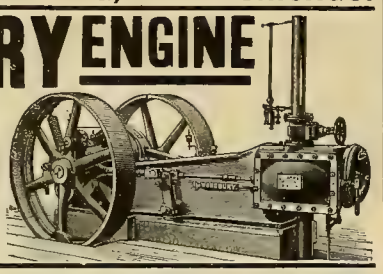

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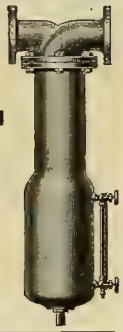

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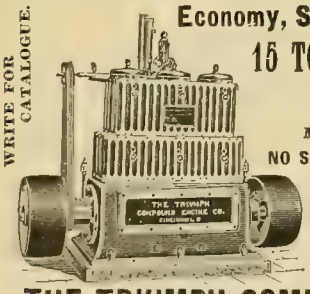

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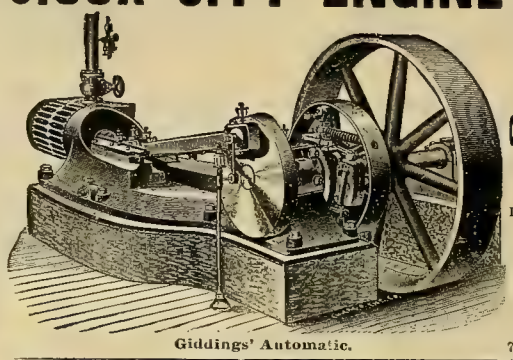

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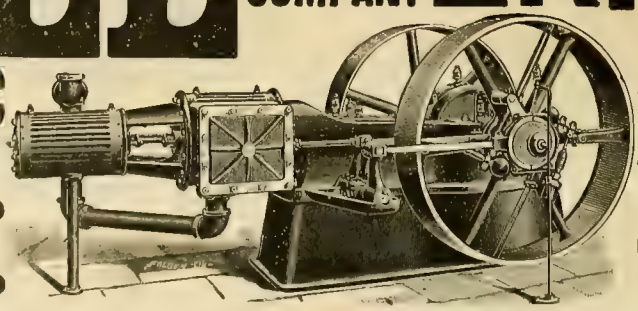

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CENTRAL UNION TELEPHONE COMPANY.
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DEAR SIRS:—For a number of years past this Company has used quite generally the LeClanche porous cups manufactured by you, and they have given us entire satisfaction, and it is our intention to continue their use, so long as conditions remain as at present.

We have not, thus far, found it necessary to take advantage of the guarantee furnished by you, as to the life of these porous cups, as they have outlived the time specified in the agreement. Yours respectfully,

(Signed) F. G. BEACH, Gen'l Supt.

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Telephone Building, 203 Washington St.,
CHICAGO, ILL., April 8, 1891.

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Yours truly,
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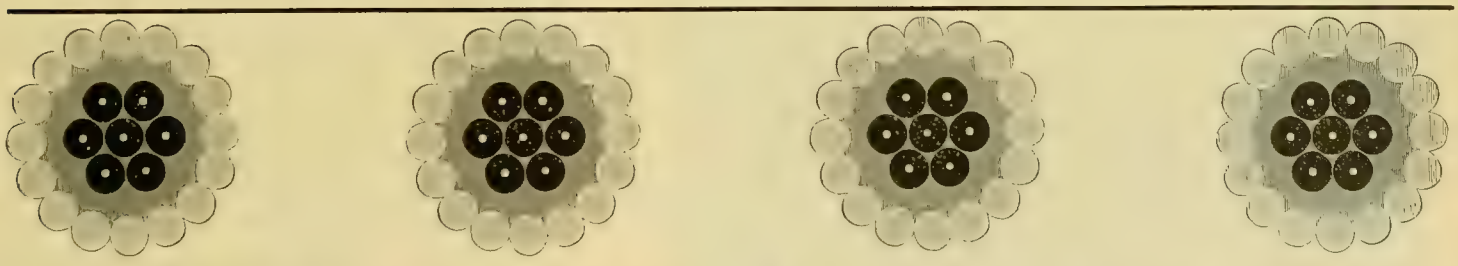
Purchasing Agent.

PRICES ON APPLICATION. **WESTERN ELECTRIC COMPANY,** **CHICAGO AND NEW YORK.**



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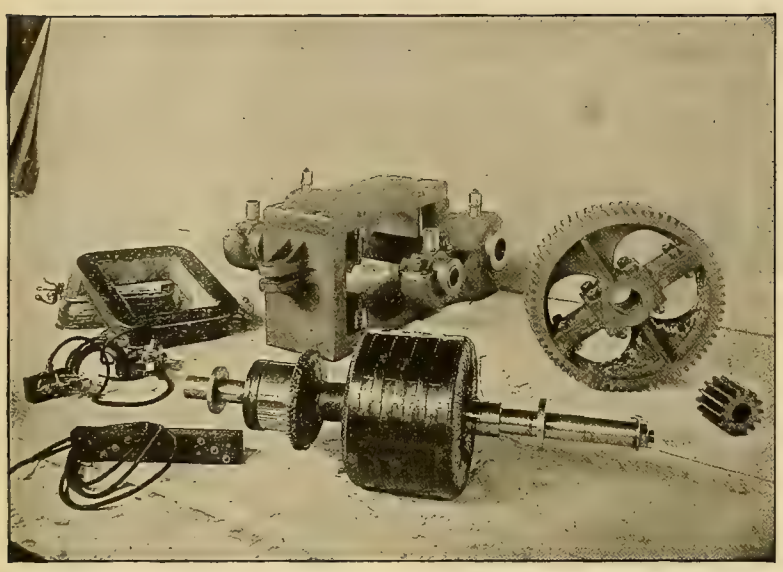

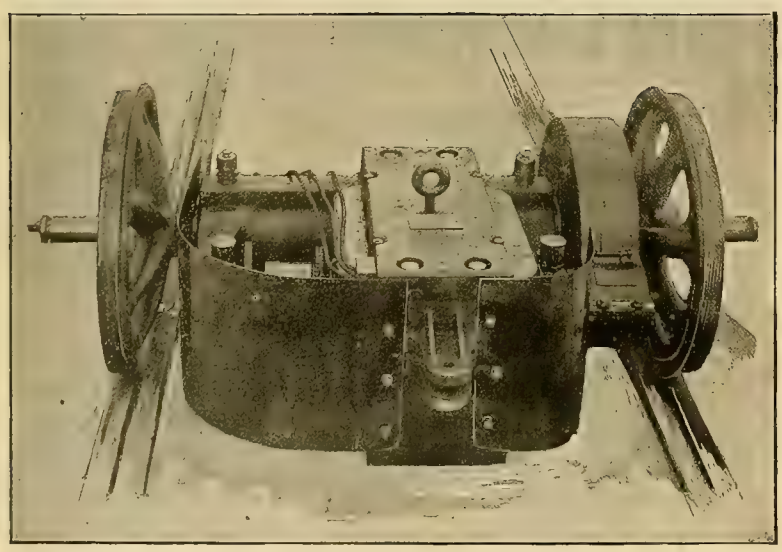

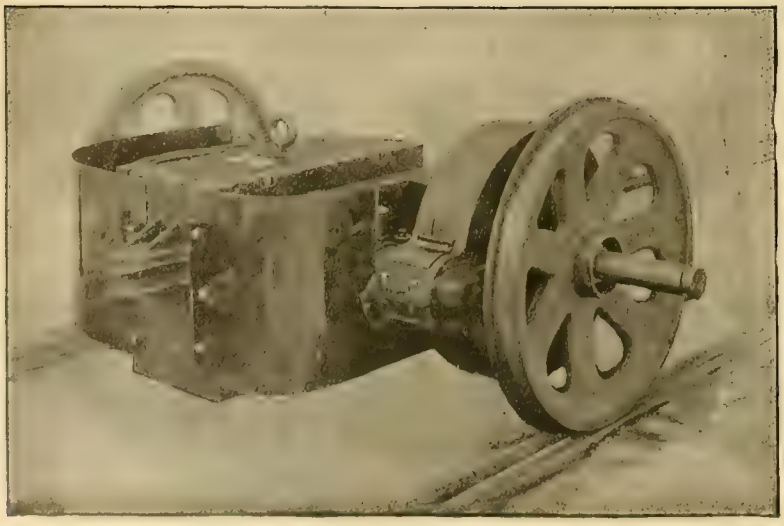

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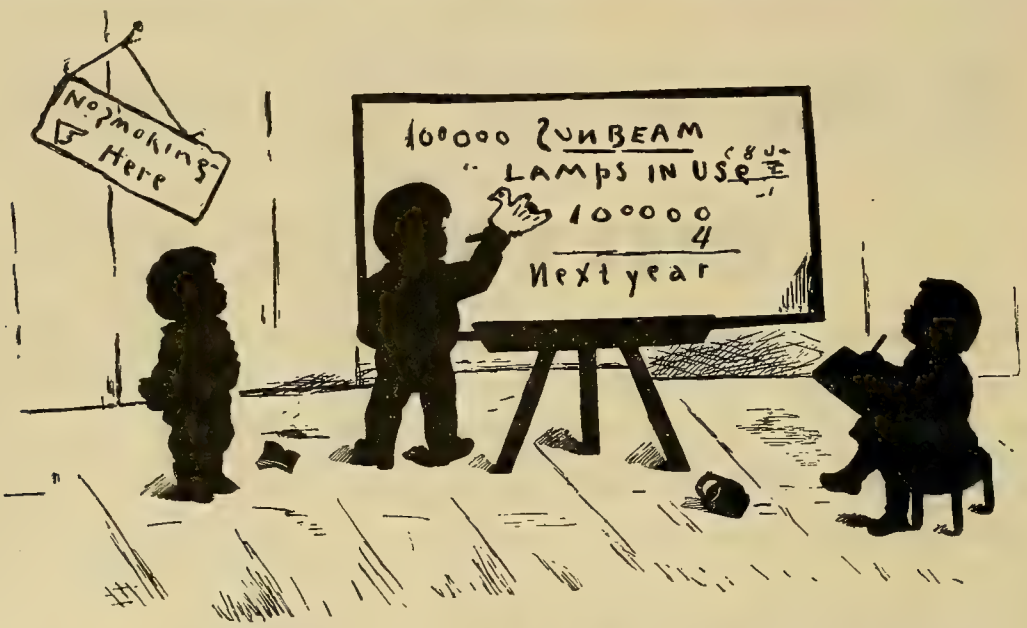

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Electrical Accumulator Company vs. Julien Electric Company, 38 Federal Reporter, 117.
Brush Electric Company vs. Julien Electric Company, 41 Federal Reporter, 679.

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Vol. VIII. CHICAGO, JUNE 13, 1891. No. 24

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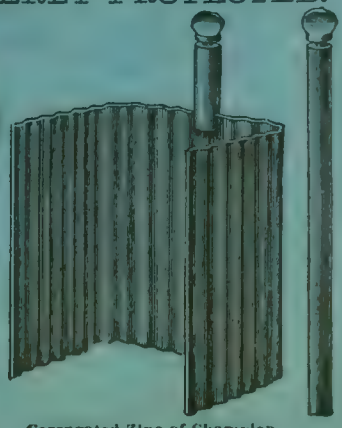

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4,150	VERMONT,	2,200
12,800	TENNESSEE,	1,485
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18,450	TOTAL,	3,685

FIVE TIMES as many of the Thomson-Houston System as of

ALL OTHERS COMBINED.

The figures referring to "total of all systems," taken from table published in August number of "Electrical Industries," for year 1890, are of undisputed accuracy.	Total of all systems.	Thomson-Houston System.	
		Number.	Percentage to total of all systems.
Vermont, - - - -	6,350	4,150	$65\frac{3}{10}$ per cent.
Tennessee, - - - -	14,285	12,800	$89\frac{1}{2}$ per cent.
South Carolina, - -	1,500	1,500	100 per cent.

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1333 F Street, Washington, D. C.
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CLASSIFIED LIST.

Accumulators.
Accumulator Co., The.
Brush Electric Co.

Aluminum.
Cowles Electric Smelting & Refining Co.
Cowles Syndicate Co.
Cleveland Aluminum Co.
Freeman, Coleman & Co.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
GreatWestern Electric Supply Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Anti-Friction Metal.
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Brush Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
McLaughlin, Jas.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co.,The.
Fletcher & Fletcher Electric Co.
GreatWestern Electric Supply Co.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Southern Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co., The.
Holtzer-Cabot Electric Co.
Partrick & Carter Co.
Queen & Co.
Stanley & Hall.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Northwestern Elect. Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co.,The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
(See Wire Insulated.)

Cable, Electric, (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Minneapolis St. Ry. Co.
Stephenson Co., John.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Chicago Electric Mfg. Co.
Bain Electric Mfg. Co.
Electric Construction & Supply Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Knapp Electrical Works.
McLaughlin, Jas.
Shawhan Machine Works.
Temple, J. C.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brush Electric Co.
Chicago Electric Mfg. Co.
Edison General Electric Co.
Electrical Engineering Co.
Fort Wayne Electric Co.
Engineering Equipment Co.
Hutton, Henry.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Temple, J. C.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Roebling's Sons Co., Jno. A.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Holmes, C. H.
Monitor Electric Co.
Southern Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Automatic Switch Co.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Paiste, H. T.
Partrick & Carter Co.
Southern Electrical Supply Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
Colburn & Co., I. W.
Electrical Engineering Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Howard & Co., Hiram M.
Heisler Electric Light Co.
Little & Co., F. P.
National Electric Manufacturing Co.
Schuyler Electric Co.
Shawhan Machine Works.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Specialties.
Illinois Electric Material Co.
Northwestern Elect. Specialty Co.
Turner Brass Works.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Engineering Equipment Co.
Pearson & Co., W. B.
Pond Engineering Co.
Sioux City Engine Works.
Stearns Mfg. Co.
Triumph Compound Engine Co.
Westinghouse Machine Co.

Engravers.
Braun Illustrating Co.

Fire Alarms.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Cleverly Electrical Works.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Cleverly Electrical Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Holmes, Booth & Haydens.
Holtzer-Cabot Electric Co.
Illinois Electric Material Co.
International Okonite Co., The.
Knapp Electrical Works.
Mason, J. W.
Monitor Electric Co.
Ostrander & Co.,W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Stanley & Hall.
Standard Electrical Works.
Thomson-Houston ElectricCo.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Globes and Electrical Glassware.
Baggot, E.
Great Western Electric Supply Co.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Butler Hard Rubber Co.
Central Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Monitor Electric Co.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Paint Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Interior Conduit & Insulation Co.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Mason, J. W.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Buckeye Electric Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Heisler Electric Light Co.
Hood, Wm.
Knapp Electrical Works.
Monitor Electric Co.
Sawyer-Man Electric Co.
Southern Electrical Supply Co.
Sunbeam Incandescent Lamp Co.

Lamps, Incandescent—Contd.
Thomson-Houston Electric Co.
Western Electric Co.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.
Partrick & Carter Co.

Mica.
Munsell & Co., Eugene.

Mining Apparatus, Electric.
Bain Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Electric Mfg. Co.
Brush Electric Co.
Baxter Electric Motor Co.
Calkins & Son J. W.
Card Electric Motor & Dynamo Co.
Crocker-Wheeler Electric Motor Co.
C. & C. Electric Motor Co.
Detroit Electrical Works.
Edison General Electric Co.
Electrical Engineering Co.
Elektron Manufacturing Co.
Hawkeye Electric Mfg. Co.
Shawhan Machine Works.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Westinghouse Electric & Mfg. Co.

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Packing.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Holmes, C. H.
Standard Electrical Works.
Southern Electrical Supply Co.
Western Electric Co.

Poles.
Brownlee & Co.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Holmes, C. H.
Milliken Bros.
Sterling, W. C.
Star Iron Tower Co.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Knapp Electrical Works.
Northwestern Elect. Specialty Co.
Partrick & Carter Co.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Separators, Steam.
Pond Engineering Co.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Street Ry. Equipment.
Minneapolis Street Ry. Co.

Supplies, Electric Railway.
Electric Merchandise Co.
Electric Railway Specialty Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Western Electric Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Standard Electrical Works.
Western Electric Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Telephones, Non-Electric.
Bostwick & Burgess Mfg. Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co

Transformers.
Stanley Electric Mfg. Co.

Trucks, Electric Car.
Detroit Electrical Works.
Edison General Electric Co.
Stephenson Co , Jno.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Hunt Machine Co., Rodney.
Leffel & Co., James.
Stilwell & Bierce Mfg. Co.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.
Partrick & Carter Co.
Roebling's Sons Co., Jno. A.

THE NATIONAL CARBON CO

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

Cleverly 1018 CHESTNUT ST. PHILA.

Electric Specialties.

WE MAKE

Electric Supplies Under Contract.

REMEMBER

That the Western Electrician enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK.

MANUFACTURED BY MILLIKEN BROS.

59 DEARBORN STREET, CHICAGO.

Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

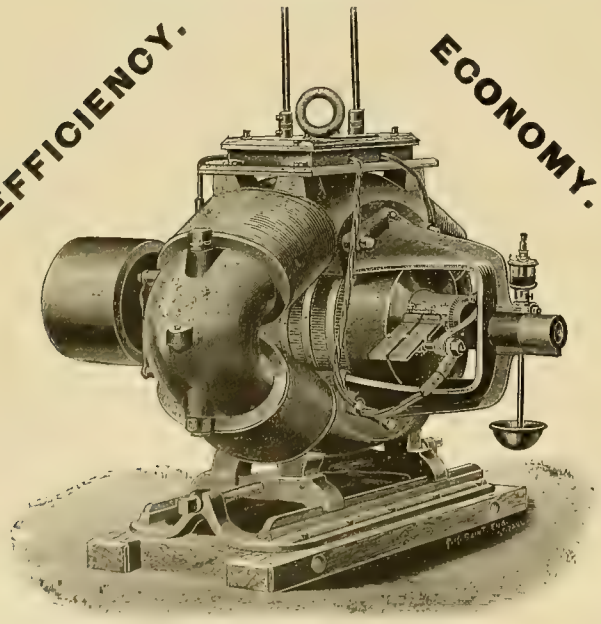
Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THOS. L. SCOVILL, New York Agent, - - - - 25 Park Place, NEW YORK.

THE HAWKEYE ELECTRIC MFG. CO.,

DAVENPORT, IOWA.

EFFICIENCY. ECONOMY.



Thone Improved Electric Machine for Light and Power.

Complete Central Station and Isolated Plants of Highest Efficiency at Lowest Cost.

ELECTRIC MOTORS

ANY VOLTAGE OR SIZE.

Reliable Agents Wanted. Correspondence Solicited. Estimates Promptly Furnished.

SOMETHING FOR NOTHING.

Send your name and address, and we will send you a sample of the

ECONOMIC INCANDESCENT LAMP

FREE OF CHARGE.

THE BEST LIGHT, THE MOST LIGHT AND THE LONGEST LIFE FOR THE LEAST MONEY.

Northwestern Electrical Specialty Co.,

GENERAL WESTERN AGENTS,

1017 Chamber of Commerce, Chicago.

GEO. L. KIRKHAM, MANAGER.

NIGHT IS DAY

WHEN THE

Sun Arc Lamp

IS USED.

Manufactured to burn on either Arc or Incandescent Circuits.

SINGLY OR IN SERIES.

HEADQUARTERS FOR HOLMES, BOOTH & HAYDENS'

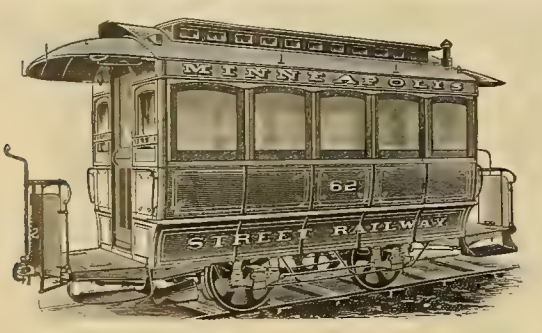
Weatherproof Line Wire.

IT HAS NO SUPERIOR.

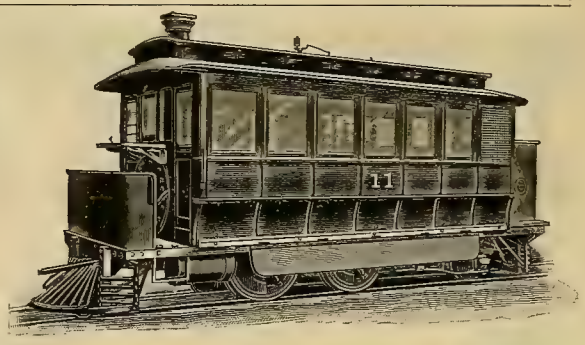
GREAT WESTERN ELECTRIC SUPPLY CO.,

Manufacturers, Dealers and Importers,

CHICAGO, U. S. A.



STREET CARS



FOR SALE

ON ACCOUNT OF

Increase of Business

AND THE

Adoption of Electricity.

THE

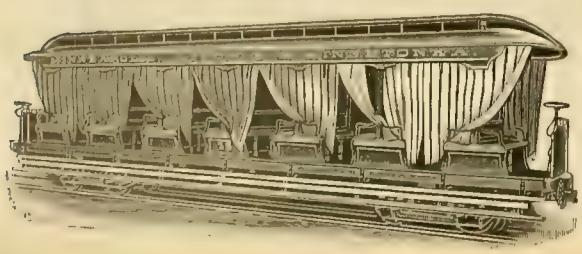
MINNEAPOLIS STREET RAILWAY CO.,

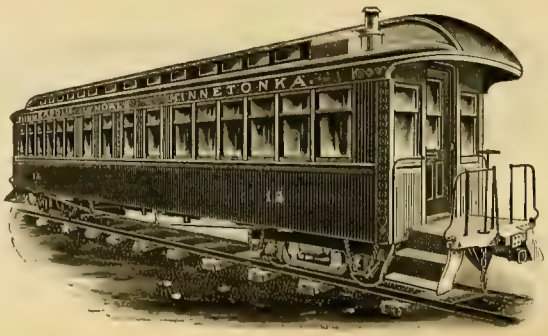
Of Minneapolis, Minn.,

OFFER FOR SALE THE FOLLOWING EQUIPMENT:

63 12-foot Cars, all fitted with Fare Boxes and "Small" Conveyors.
76 Extra "Small" Conveyors for 14 and 16 ft. Cars.
63 Extra "Slawson" Fare Boxes.
12 Steam Motors, 15to 20 Ton.
2 Locomotives and Tenders, 20 and 25 Ton.
21 Passenger Coaches, 26 to 40 ft.
34 Open Passenger Excursion Cars, 34 ft.
8 Flat Cars, 30 ft.

Most of the cars have been in service only a short time, and all are in first-class condition. We can make changes or alterations and fit them up to suit, and will sell very cheap. The gauge of any of the cars can be changed to suit purchaser. Full description and photographs mailed upon application.





Our St. Louis Branch:
Southern Electrical Supply Co.,

OKONITE
TRADE MARK.

823 Locust St.,
ST. LOUIS, MO.

NICKEL-PLATED

Speaking Tube Whistles.

WITH OR WITHOUT INDICATORS.

Our Kansas City Branch:
Gate City Electric Company,

OKONITE
TRADE MARK.

572 Delaware St.,
KANSAS CITY, MO.

WE HAVE A

LARGE STOCK

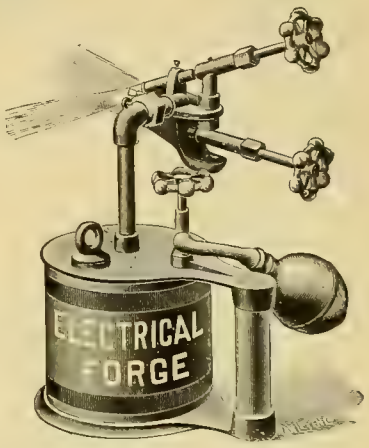
of these **SPEAKING TUBE WHISTLES** on hand, which we will dispose of at the following prices:

1	dozen	lots,	$2.00.
5	"	"	1.75.
10	"	"	1.50.
25	"	"	1.40.
50	"	"	1.35.
100	"	"	1.30.

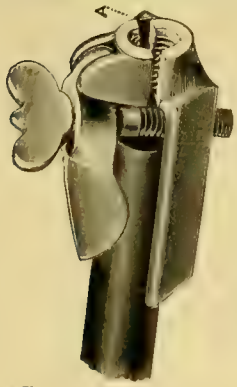
Electrician's Torch.

The ELECTRICIAN'S TORCH

Is safe, durable, easily repaired, has a reversible burner that can be used in any position and will not blow out in a gale of wind. Can be used as a Blow-pipe Torch or a Fan-tail Heater and can be instantly changed from an intense heat to a feeble flame, or the reverse.



No. 1. Helper Forge.



Upper Carbon Holder.

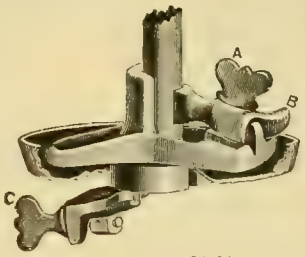
The No. 1 HELPER FORGE

Can also be used in the highest wind. One gallon of 74° deodorized gasoline will run it all day. It is made to stand hard work.

These

CARBON HOLDERS

Are designed especially for Thomson-Houston and Brush lamps, and are sold at very low prices. We also have a lot of Thomson-Houston lower carbon holder rings.



Lower Carbon Holder.

We are now exclusive Western Agents for

Commercial Fire-Proof Lamp Cord, Packard Incandescent Lamps, Bryant Sockets (all Porcelain and Brass), **Okonite Wire, Improved Candee Wire.**

Our Omaha Branch:
Western Electrical Supply Co.,

OKONITE
TRADE MARK.

418 S. 15th St.,
OMAHA, NEB.

CENTRAL ELECTRIC COMPANY,

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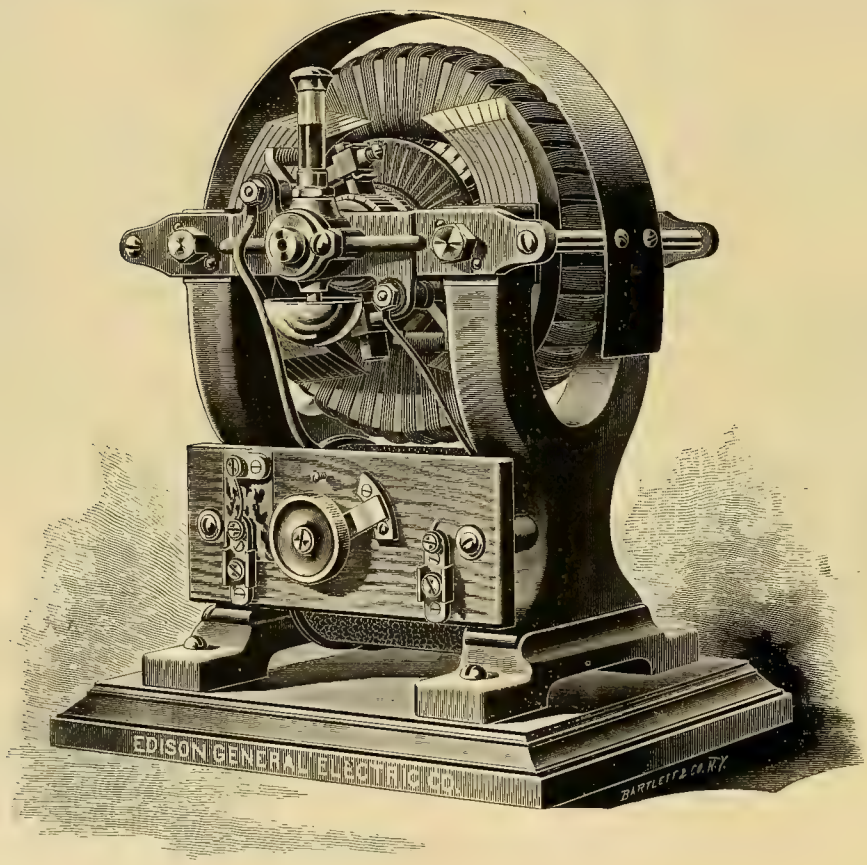

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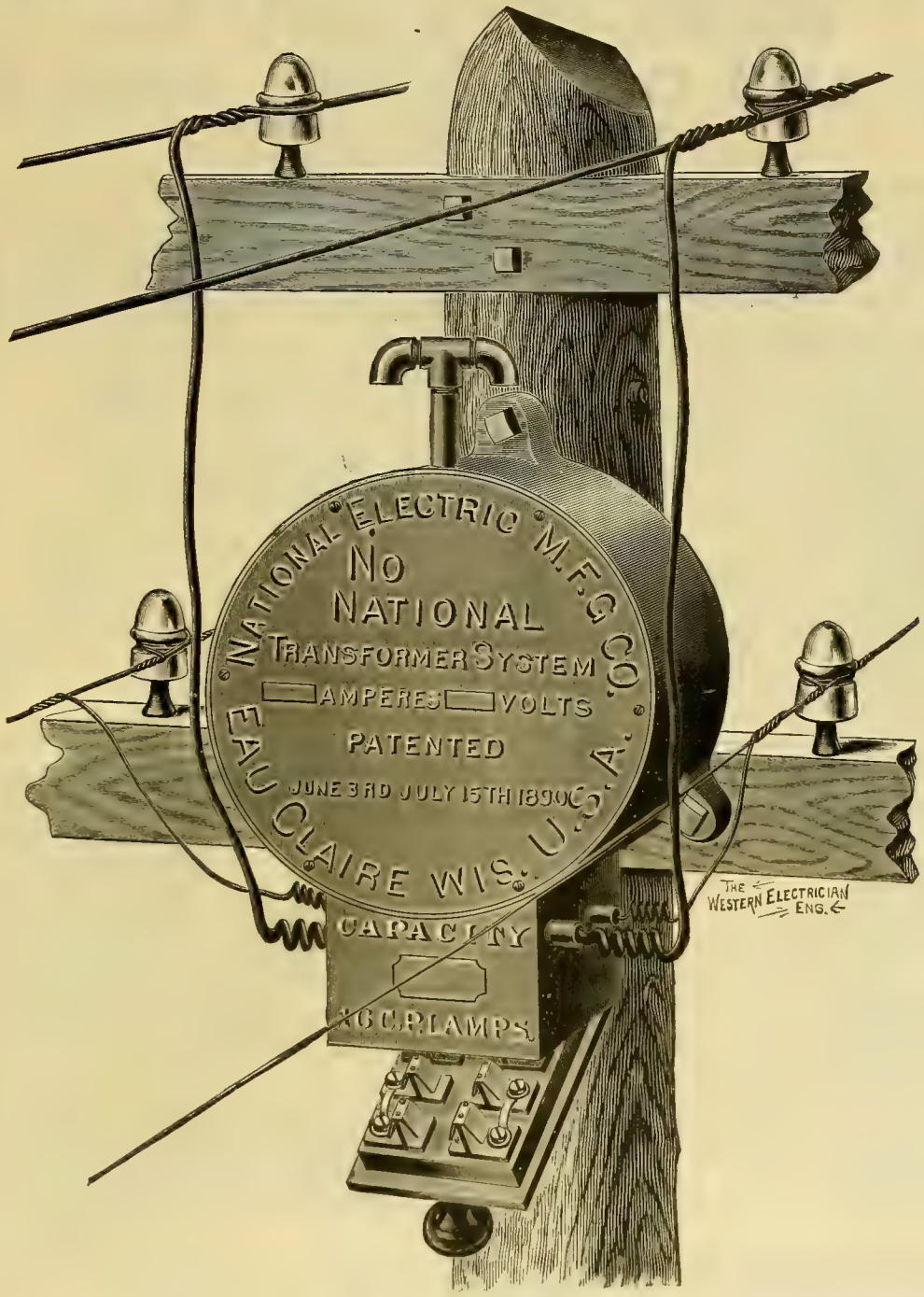

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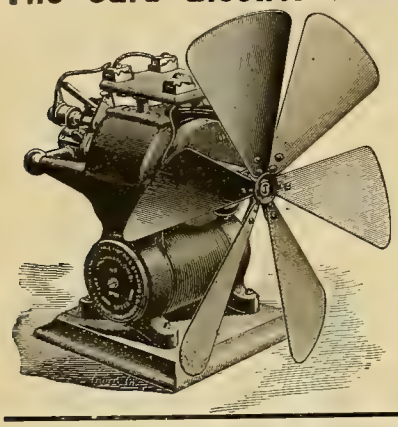

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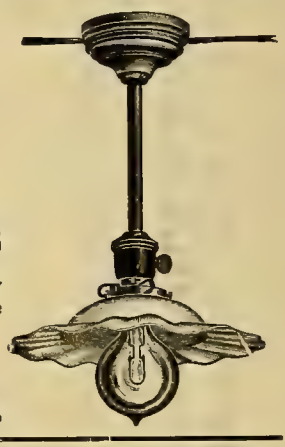

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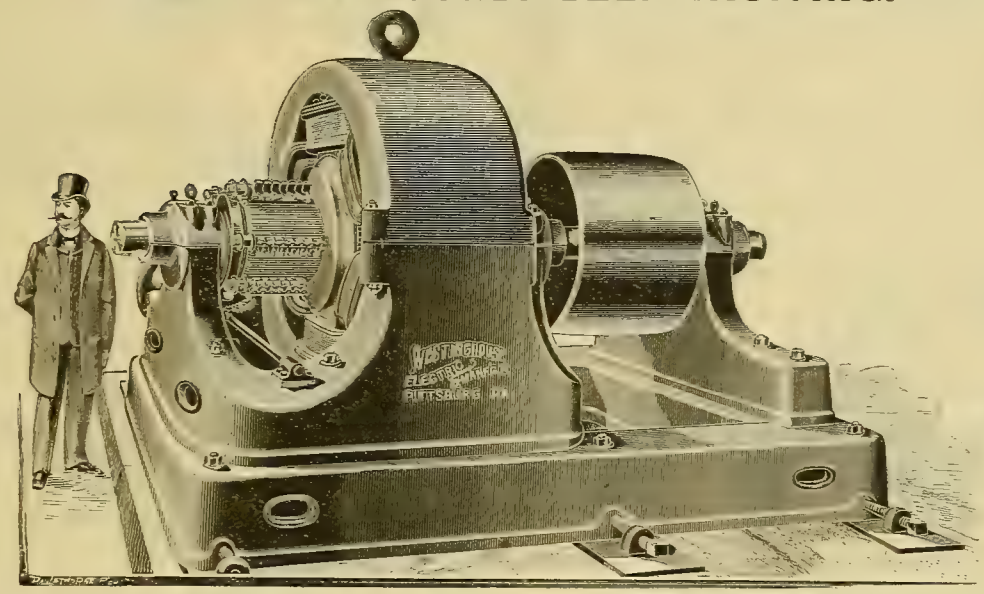

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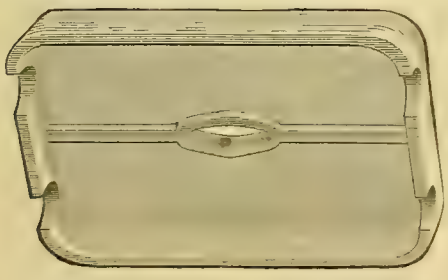

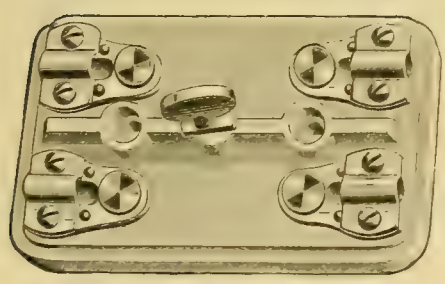

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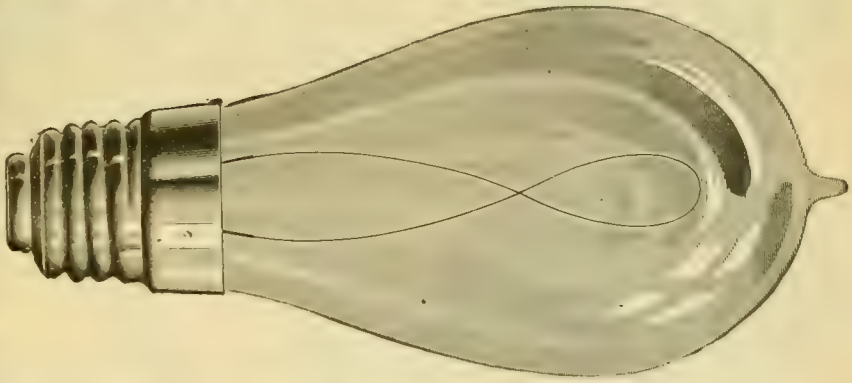

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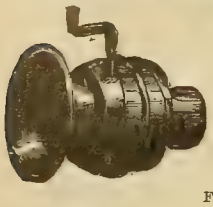

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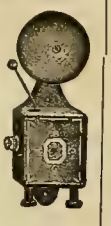

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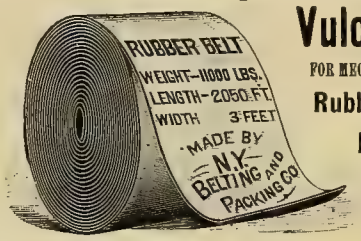

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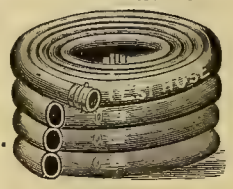

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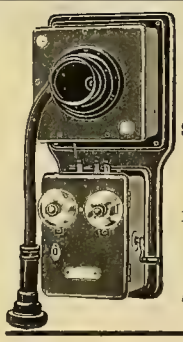

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The Degenhardt-Keller Conduit Systems for Electric Street Railways.

That a demand exists for a reliable electric street railway equipment in which there is no overhead construction is now generally admitted. While the overhead wire, as a rule, is not objected to, there are nevertheless many instances where the electric system would replace other and less efficient equipments, could the current be delivered to the car motor by other means than through a conductor strung overhead.

Recognizing the advantages that would accrue through the employment of a system of conductors laid entirely underground, Fred. E. Degenhardt of the Standard Underground Cable company, Chicago, has devised two conduits which possess a number of novel and valuable features. Mr. Degenhardt, it may be mentioned, has been identified with underground electrical work for a number of years, and in developing this equipment had associated with him Electrical Engineer E. E. Keller of the North American Construction company, Chicago.

The general design of one of the conduits is shown in Figs. 1, 2 and 3. Figs. 4 and 5 represent the main features of another system which is also being exploited by Messrs. Degenhardt and Keller.

In designing the system illustrated in Figs. 1, 2 and 3 the fundamental idea was to have a closed conduit and one in which the supply conductor was entirely insulated except at the point over which a car was passing.

The manner in which the details have been worked out will be understood by reference to the lettered parts, Figs. 2 and 3.

The conduit proper *M*, which was designed to be laid on top of the cross-ties, is built of circular sheet metal tubes in sections about four feet long, with a cast-iron yoke for each tie. The tube is about ten inches in diameter, and has the upper portion cut away so as to form the top of the conduit; in other words, the tubes are formed simply of sheet iron rolled into a circular form. This is not shown in Fig. 1, as there the whole conduit is cast in pieces. The slot rails are shown to the left in Fig. 1. These are of steel, and are bolted onto the top of the conduit. Resting upon lugs in the conduit proper, is the series of cast-iron troughs *T T*, Figs. 2 and 3. The conduit is filled throughout its entire length with troughs abutting as shown, and each one is filled with oil of a greater specific gravity than water. These chambers, which are about three feet in length, are covered, as shown by overlapping lids *C*. The lids *C* carry a contact rail *O* which is electrically connected with two flexible downwardly projecting pieces. Each lid has also on its under side a bow spring *S*. The supply conductor passes from trough to trough through stuffing boxes, and is supported in the oil in each chamber on two porcelain blocks *P P*. The bow springs rest on the porcelain insulators and throw up the lids so as to close the slot. The joints between the sections are formed like a gear tooth and its space, as indicated at *J* in Fig. 2. A glance at Fig. 1 will enable the reader to appreciate more clearly the simplicity of the system in its entirety.

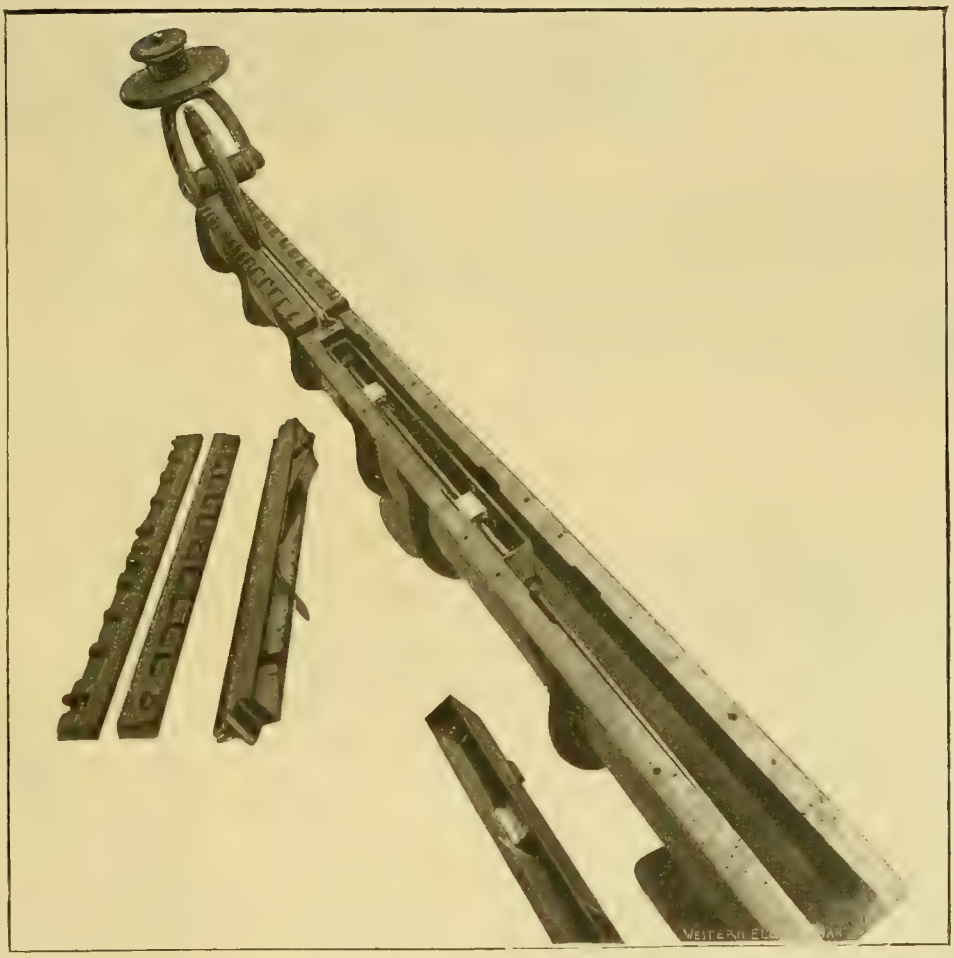


FIG. 1. THE DEGENHARDT KELLER CONDUIT SYSTEMS FOR ELECTRIC STREET RAILWAYS.

The operation of the conduit may now be explained: When there is no car passing, the springs *S*, which extend down through the oil and bear on the porcelain blocks, keep the contract bars not only insulated but elevated, so as to close the slot. The trolley which is attached beneath each car, as it moves along pushes down each lid in turn and presses its two contact pieces into sliding contact with the trolley wire. This action, it will be seen, effects what might be termed a momentary connection between the supply wire and the car motor. As soon as the trolley wheel has rolled three feet and run onto another section, the spring attached to the first lid elevates it, breaking the contact with the supply conductor and closing the slot.

In practice there will be a space of two inches between the wire carrying the current and the metal pieces *O O* which make connection with the 36-inch sections. On this account if a pedestrian should depress the center rail with a cane or umbrella, or if the wheel of a vehicle should run into the slot, it would be practically impossible to make contact with the live wire, submerged in the oil below. In addition to this, as the springs on one 36-inch section are made heavy it would require considerable effort to depress one section two inches, and a far greater amount of force to depress two sections at their ends.

Figs. 4 and 5 are sectional views, one through a manhole and the other through the conduit proper, of another system in which the current is conveyed from the feeder wire in the conduit to the moving vehicle without the use of any slot-closing device.

In this equipment as in the one just described, sections of a working conductor are brought by the pressure of a trolley successively into contact with a supply conductor. Manholes, Fig. 4, are located along the conduit 24 feet apart, and the channel iron working conductor is divided into sections 24 feet in length. Each section of the working conductor is supported on yokes hung in the manholes from swinging bars *A*, as shown. The feeder for the system passes from manhole to manhole making electrical connection with contact clips *N* in each manhole. The clips are incased as indicated in a tight box *B* filled with oil. The piston *H* works into box *B* through a stuffing box. This piston is electrically connected as shown near its outer end with the channel iron; its inner end is fitted with a flat metal piece for making contact with switch-clip *N*. A lug connected with the swinging conductor engages the piston *H*.

The action of the system is as follows: When the trolley comes along it presses the bar with its yokes toward the left 1½ inches, and closes the circuit through the switch jaws *N*, thus giving current to one section of the channel bar. The switch jaws take current from the feeder through a safety fuse.

When the trolley is out of the way, the iron channel bar swings back 1½ inches toward the center of the conduit, and is prevented from swinging further by the yoke coming in contact with a lug. When in this position the hangers *A* are not quite vertical, so

there is a slight pressure against the projection. In this way the channel bar and the yoke, by means of a lug, act to draw out of contact piston *H*.

In operating the conduit it is the intention to have one car out of the entire equipment carrying a wire brush directly behind the trolley. This brush will fill the conduit, and sweep all dirt into dirtholes, which are to be a foot or so deeper than the conduit and manholes.

It will be noticed that the latter system has in it neither magnets nor springs, also that in both systems there can be no arcing at the points of the switch, as the circuit is never opened. The contact in front is made before that in the rear is broken.

Electrical Department, World's Fair.

One of the greatest features of the World's Columbian Exposition, according to the present plans, will be the transmission of power by electricity. It is now definitely announced by the Department of Construction that Engineer Gottlieb's scheme for transporting steam long distances in pipes has been abandoned. Instead, the greater part of the power used on the grounds will be converted into electricity at the great power station and thence distributed to the various buildings by conductors laid in subways. Probably the greater part of machinery in Machinery hall will be run by steam power supplied from an adjoining power house, but in all other departments electric power will be used almost exclusively. When it is stated that probably four or five thousand horse power will be needed in one building alone, the magnitude of the plan will be appreciated. It will be the greatest demonstration of the practical, commercial value of the application of electricity for power transmission ever known, and may perhaps be considered as the climax of the marvelous development of electrical science in the nineteenth century.

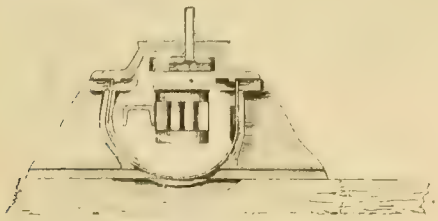


FIG. 5. THE DEGENHARDT-KELLER CONDUIT SYSTEMS FOR ELECTRIC STREET RAILWAYS.

The leading outlines of the plan have been agreed upon at several recent conferences of Chief Barrett of the Department of Electricity, and Chief Burnham of the Construction Department, while the details have, to some extent, been elaborated by Frederick Sargent, in consultation with the other engineers connected with the Construction Department. It is proposed to construct subways of a diameter sufficiently large to permit a man to walk through, say six feet. The conductors will probably be suspended on brackets or arms projecting from either side, leaving a passage way in the center, access to which will be had by man-holes provided at convenient distances. The subways will be made large enough to accommodate the maximum number of conductors that will be needed, but the amount of power may be increased as found necessary. In crossing the lagoon the conductors will be attached to the under side of the bridges. The electric light wires will also be carried in the subways.

By this means, it is thought, each manufacturer of electrical machinery can put in his own generator, run his wires and operate his motors by his own current. Exhibitors in other departments requiring power will, of course, be permitted to select whatever motors they may desire. One advantage of the plan will be to obviate the use of much belting and shafting.

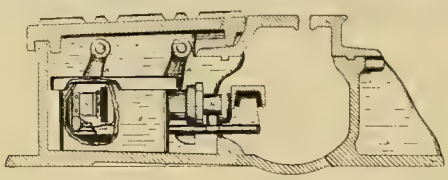


FIG. 4. THE DEGENHARDT-KELLER CONDUIT SYSTEMS FOR ELECTRIC STREET RAILWAYS.

It is probable that a large force of draughtsmen will soon be put at work under Mr. Sargent preparing plans for the subway system. As yet, however, the route has not been determined. Prof. Barrett, as chief of the Department of Electricity, will represent the electrical exhibitors and have general charge of the planning of the generating plant, the placing and insulation of the conductors, connections and requirements of the electrical building, etc. His ideas will be formulated by the electrical engineer of the department, who will in turn act in conjunction with Mr. Sargent. This will leave Secretary Hornsby free to attend to the business end of the department. This official will, under the direction of Prof. Barrett, attend to the correspondence with prospective exhibitors, make the calculations for space and have general charge of the office work. He has already engaged a stenographer and intends shortly to issue a circular to the electrical industries throughout the country setting forth exactly the conditions that will obtain in the electrical exhibit.

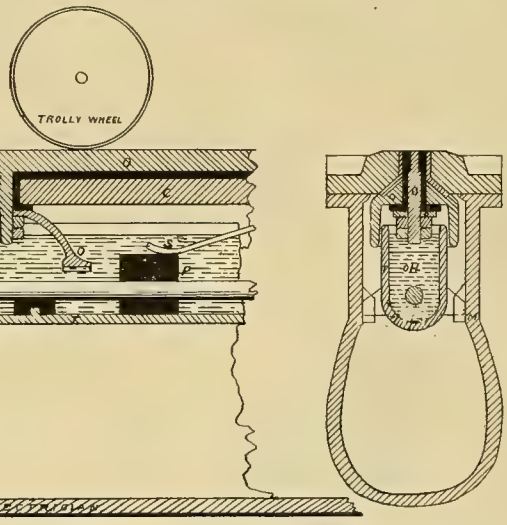


FIG. 2. THE DEGENHARDT-KELLER CONDUIT SYSTEMS FOR ELECTRIC STREET RAILWAYS.

Last week all but one of the contracts for the construction of the electrical building were awarded by the committee on grounds and buildings. The names of the successful bidders, with the amount of their bids, follow:

Arthur Johnson & Bro., Omaha, carpenter and iron work	$166,444
John Griffiths, Chicago, lathing and plastering	6,000
W. P. Nelson & Co., Chicago, painting and glazing	6,522
Park & Bates, Chicago, staff and ornamental and exterior finish	85,000
	$263 966

The contract for the roofing was held in abeyance, although several bids were received. A similar course was pursued in the case of the mining building. The delay is caused by the fact that the plans for the roofing material may possibly be altered, as doubts have been expressed as to whether a felt roof, which was specified, would last for the required time. Henry F. Cady, a joint bidder with Johnson & Bro., when asked by a reporter when work on the building would be begun, replied:

"Almost at once. I should say that within two weeks I will be unloading lumber on the ground. The material used will be mostly yellow pine, shipped here from Texas and Arkansas. The specifications say that the work must be completed by Feb. 15, 1892, and I have no doubt we shall be through on time."

The American correspondent of the London *Electrician*, writing of the World's Fair, says that "the feeling now is that the electrical exhibits should be consolidated as far as possible, and not scattered as the architects' fancy would dictate."

Interest in the controversy over the electrical building continues, despite the fact that it has practically been closed. Commenting on the lack of space devoted to this department, *Modern Light and Heat*, Boston, says:

> Mr. Edison's visit to Chicago has had the effect of drawing the attention of the commissioners and other officials of the World's Columbian Exhibition to the problem of the electrical exhibit in a very decided and energetic manner. The WESTERN ELECTRICIAN for May 23d contains a full account of the outlining features of the exhibit as projected by the fair officials, and points out clearly the inadequacy of their proposed arrangements. In his interviews with Professor Barrett, the great inventor outlined his ideas of just what such an exhibit should be. We are glad to notice that Mr. Edison favors a combined exhibit, and deprecates the plan of spreading the various exhibits throughout different buildings. Mr. Edison also says the proposed building will not be large enough to do justice to the progress of electrical applications, and that the power will be ludicrously inadequate to the demand. In fact, Mr. Edison's visit brings to light a sad lack of enthusiasm upon the part of the electrical department officials. Surely this is not as it should be. What is the matter with the woolly, windy city? Where shall we look for enthusiasm and the intelligent push which surmount difficulties apparently insurmountable, if not to Chicago? And with an agent so flexible as electricity, which can be utilized in an infinite number and variety of ways, with a beauty and originality which simply cannot be equaled in any other industry in the world, what tremendous possibilities are within their reach! Let us have a building big enough, ample power to run the apparatus, and a rational enthusiasm of the officers, and the electrical department of the World's Columbian Exhibition will surpass, in instructiveness and attractiveness, any half-dozen other departments in the entire fair.

It should be remarked in this connection that the chief of the Department of Electricity has done everything in his power to secure for the electrical interest the requisite space for a united exhibit. Whatever blame there is to be attached to fair officials shou'd be laid to the Construction Department, which was responsible for the plans and allotment of space, and the committee on grounds and buildings, which approved the action of Chief Burnham of the Construction Department.

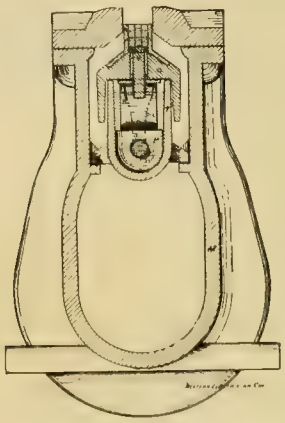


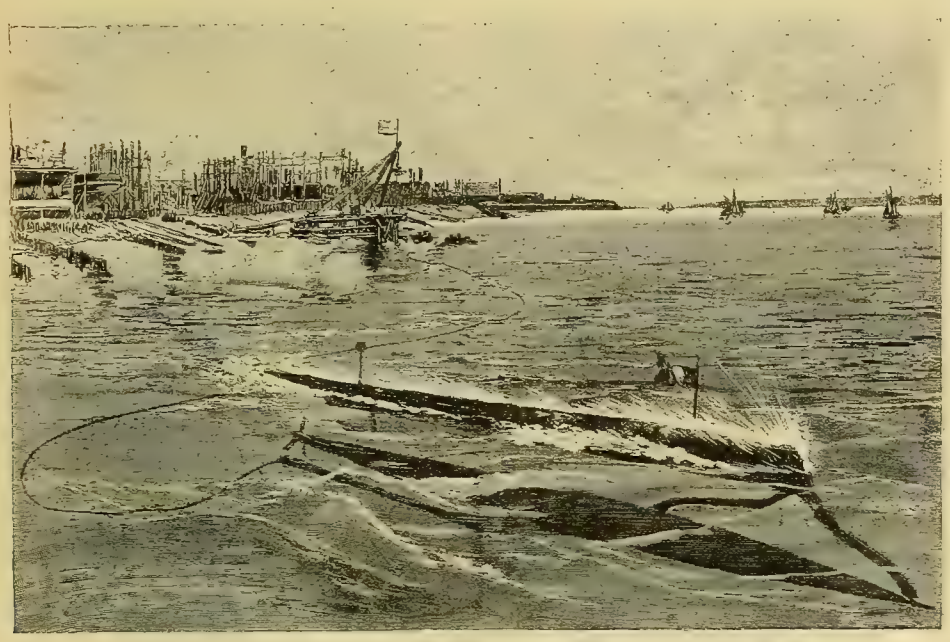
FIG. 3. THE DEGENHARDT-KELLER CONDUIT SYSTEMS FOR ELECTRIC STREET RAILWAYS.

Prof. Barrett, who has been indisposed for the last week or two, left for Michigan City with his family last Saturday. He expected to be back in two or three days, but a telegram received from him on Monday stated that his stay would be prolonged a week or more.

It is proposed to connect Belgrade and Topschider, in Servia, by an electric railroad.

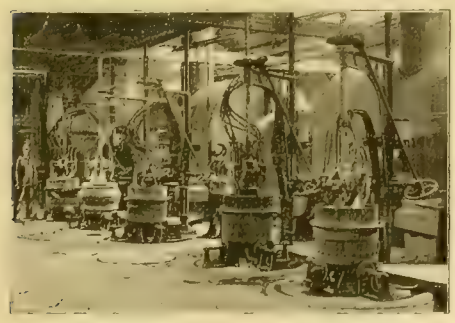
Sims-Edison Automatic Torpedo.

An interesting experiment with a new electrically propelled torpedo was recently made at the naval station of Greville, in the harbor of Havre, France. The distinguishing feature of this torpedo, which is the Sims-Edison, is that the operator, stationed at the place of departure, retains complete control over it. By means of electricity it can be guided in any direction, stopped or exploded at the will of the operator on shore or on board a war-ship.



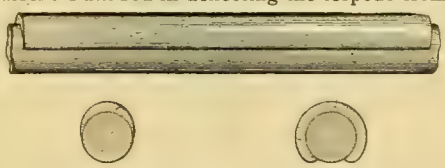
SIMS-EDISON AUTOMATIC TORPEDO.

The torpedo consists of two distinct parts. The upper portion or floater is built of sheet copper and filled with a buoyant material that serves to support the lower part, or torpedo proper, the whole remaining submerged at a fixed depth below the surface of the water. The torpedo, which has the common cigar shape, is divided into four compartments, of which the first contains the explosive, 450 pounds of dynamite or gun-cotton. The second compartment is filled with air, which, beside counteracting the weight, serves to separate the explosive from the mechanism of the torpedo. In the third chamber is coiled 10,500 feet of two wire cable, well insulated and carefully wound on a movable spool. The cable is 0.4 inch in diameter and its specific gravity is exactly that of water, so that when the cable is wound off the spool and water takes its place in the compartment the total weight of the torpedo is not changed. The rear compartment gives room for an electric motor directly connected to the propeller and making 800 revolutions per minute, producing a speed of 20 knots an hour. The motor is furnished with a governor for regulating its speed. The total weight of the torpedo is 2,720 pounds, and its length is 24 feet. It is placed in the water through a tube in the same way as any ordinary torpedo.



FROGES ALUMINUM PLANT, GRENOBLE, FRANCE.

A small mast surmounted by a red ball projects above the surface of the water and enables the operator, whether on shore or in a vessel, to follow and regulate the movements of the torpedo. A continuous current dynamo of a capacity of 25 amperes at 1,300 volts furnishes the power. The current is passed through a rheostat to the cable of the torpedo. The terminals of the cable are joined to the commutator of the motor in such a way that the unwinding of the cable is governed by the rotation of the motor armature. The motor is a two pole machine wound in series, so that the reversing of the current does not alter the direction of its rotation. The reversing of the current is utilized in deflecting the torpedo from side to side and is accomplished by the aid of a polarized relay, which is mechanically connected to the rudder.



IDE'S PROTECTED TROLLEY WIRE.

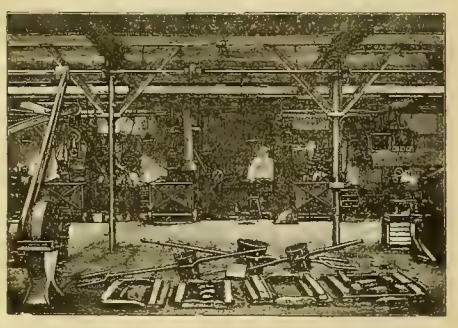
Another purpose served by the electric current is that of exploding the torpedo. An electro magnet having an armature balanced with a spring is joined in the circuit, but remains undisturbed as long as the current does not exceed the average speed. When an explosion is desired, the operator draws out his resistance; the increased current then attracts the armature of the magnet and causes a short circuit through the explosive compound.

At present it is impossible to advance an intelligent prediction as to the merits of the Sims-Edison torpedo in actual warfare, but as a new and ingenious application of electricity in naval service the invention is unquestionably of great interest. The cuts are reproduced from *L'Illustration.*

SIMS EDISON AUTOMATIC TORPEDO.

Froges Aluminum Plant at Grenoble, France.

The accompanying illustrations represent the Froges aluminum plant, allusion to which has heretofore been made in the WESTERN ELECTRICIAN. This plant is located on the river Adrets, near Grenoble, France, and is one of the largest aluminum works in Europe. This and the Neuhausen works in Switzerland were among the first to use electricity on a large scale in the production of this important metal. The plant consists of two turbines of 600 horse power and two dynamos each capable of generating 6,000 amperes at an electromotive force of 15 volts. Current for the illumination of the plant is furnished by a third dynamo driven by another turbine of 100 horse power.



FROGES ALUMINUM PLANT, GRENOBLE, FRANCE.

The cuts were reproduced from *La Nature.*

Ide's Protected Trolley Wire.

The cut presented herewith illustrates a method proposed by A. L. Ide of Springfield, Ill., by which a trolley wire could be made harmless as far as making contact with other wires is concerned. Mr. Ide's idea is to cover the upper portion of the trolley wire with non-conducting material, and leave the lower portion exposed, as indicated, for contact with the trolley wheel. The insulating shield is tapered at its edges, in order that the curved flange of the trolley may the more readily remain in con-

tact with the wire when the car is rounding a curve. The thin portions are sufficiently thick, however, to cause a crossing wire that might happen to fall upon the coating and hang downwardly, to stand out from the trolley wire.

Experiments with High Tension Currents at Berlin.

The firm of Siemens & Halske, Berlin, Germany, has for a couple of years been experimenting with converters for high tension current, and also with conductors and insulators suitable for this system of electrical transmission. In opposition to similar experiments made

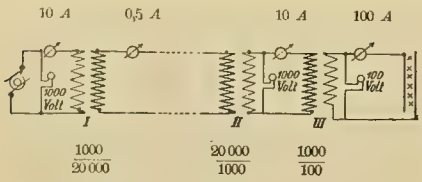


FIG. 2. EXPERIMENTS WITH HIGH TENSION CURRENTS AT BERLIN.

at the Oerlikon factory in Zurich, Switzerland, described in the WESTERN ELECTRICIAN, April 4, 1891, this concern has been working to abandon the use of oil insulation for converters. It has undertaken the task of finding a dry material that would be as effective as oil, hoping that whatever good results might be obtained would prove valuable in the construction of high insulation cables as well as in converters. A series of experiments in this line was re-

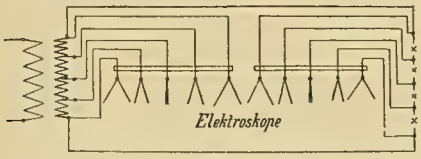


FIG. 3. EXPERIMENTS WITH HIGH TENSION CURRENTS AT BERLIN.

cently made at the club rooms of the Electrotechnical society in Berlin, by Dr. Koepsel, who read an interesting paper in explanation.

The apparatus employed in the lecture room consisted of three converters of different construction, but of an even capacity of 10,000 watts; a group of 200 incandescent lamps (10 candle power, 120 volt) connected in series, and another group of 200 lamps (16 candle power, 100 volt) connected in multiple. In addition to

FIG. 6. EXPERIMENTS WITH HIGH TENSION CURRENTS AT BERLIN.

this there was a complete set of instruments for indicating the current, electromotive force, etc. A 1,000 volt, 10 ampere, Siemens & Halske alternating dynamo supplied the current. This machine was located at the factory, whence the current was carried for a considerable distance to the club-room. Copper conductors of a carrying capacity equal to No. 12 B. and S. gauge, supported by oil insulators, Fig. 1, were used. The wires were joined to converter No. 1, Fig. 2, and the dynamo current of 1,000 volts and 10 amperes was transformed into 20,000 volts, also 0.5 ampere. Through converter No. 2 the tension was again reduced to 1,000 volt, and through converter No. 3 to 100 volts and 100 amperes. At this pressure, 100 volts, the current was fed to the second group of lamps, supplying the 200 16 candle power, 100 volt lamps in multiple. Volt and ampere meters indicated during the display the exact condition of the current, and also the loss of energy in converting. As one experiment the current was taken from the secondary coil of converter No. 1, with a tension of 20,000 volts, and was carried through a fine wire to the first group of 200 lamps (10 candle power, 120 volt) connected in series. The current consumed in these lamps proved to be only 0.3 ampere. During the experiment an interesting phenomenon was observed in the lamps. The carbon filaments in the outside lamps of the series were noticed to vibrate rapidly, the rate of vibration decreasing in the lamps toward the center of the group, where the filament remained quiet. The cause of this vibration was explained by means of an electroscope, Fig. 3. From five points of

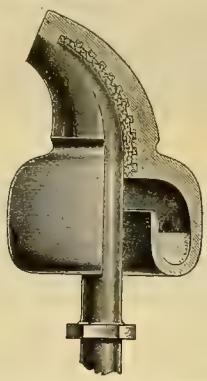


FIG. 1. EXPERIMENTS WITH HIGH TENSION CURRENTS AT BERLIN.

the windings of the secondary coil in the converter and from corresponding points in the lamp group wires were connected to two sets of foil electroscopes supported by rods of hard rubber. The connections were such that the two terminal wires, both from converter and lamps, were joined to the two outside foils of each group, and the center wire from each side to the center foil of the electroscope, and so on. In sending a current through the converter and lamps it was found that the outside foils of both sets would diverge considerably, while the foils next to them would be less disturbed, and the foils in the center would remain uninfluenced. Dr. Koepsel explained this as a proof that there are two points in the circuit where the difference of potential between the circuit and the earth is zero, and that these points when accurately determined can be touched without feeling the slightest shock, although the current and consequently its tension is the same at any point throughout the whole circuit. In approaching the terminals the difference of potential between the circuit and the earth increases. It was found that if a body in connection with the earth was brought near the lamps the filament was alternately attracted and repelled. The vibration of the filament, however, could not keep pace with the alternations of the current; when moving at the same rate, however, the filament would sometimes strike the side of the glass globe and break off.

The electroscope was also used in testing to ascertain the possibility of an electric charging of the iron casing of the converter, but the foils did not show any deflection and the potential did not vary from that of the earth. In considering the question of the difference of potential between the converter circuit and the earth another interesting point was brought out. A wire was connected from one of the terminals of the secondary coil of a converter, Fig. 4, to any part of either the secondary or primary coil of another converter, and sparks of 0.4 inch, accompanied by rattling reports, were drawn from any metallic part by means of a wire with ground connection. This experiment showed the necessity, where several converters are joined in multiple, of having all connections broken when the device is not in use.

Experiments were also made showing the insulating resistance of several well-known insu-

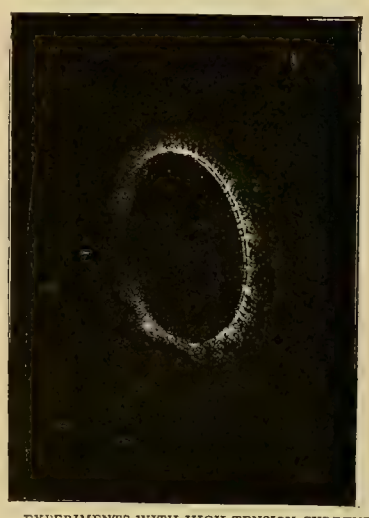


FIG. 5. EXPERIMENTS WITH HIGH TENSION CURRENTS AT BERLIN.

lating materials. A soft rubber disk of 0.04 inch thickness was placed between two brass disks each four inches in diameter. In this test the current would flow from one pole to another across the edge of the rubber disk with much sparking and rattling. It would not penetrate the rubber disk until a potential of 10,000 volts was reached. A disk of hard rubber would resist a tension of 20,000 volts without being pierced by the current. A glass disk of 0.12 inch thickness was also placed between the brass plates, and the discharge of current across its edge presented the striking effect illustrated in Fig. 5 as a photographic view of this experiment.

To ascertain the resistance of oil there was employed an apparatus consisting of two brass cups adjustable by screws and immersed in an oil bath. A current of 20,000 volts would strike through 0.12 inch thickness of oil transforming the oil at the points of contact into a cloudy mixture evidently consisting of carbonized substances.

Further experiments were made with air resistance, Fig. 6. An apparatus having ball shaped pole pieces 0.4 inch in diameter would discharge 20,000 volts through a space of 0.4 inch. With brass disks of 1.6 inches diameter, the distance for the same current would increase to 0.8 inch, and with cone shaped poles of 45 degrees the space would be 1.2 inches. In this last experiment there was observed the electrical phenomenon known as St. Elmo's Fire. This effect was noticed just before the actual discharge took place. The discharge between the pole pieces

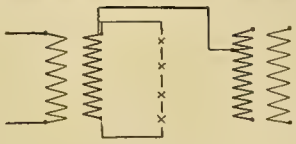


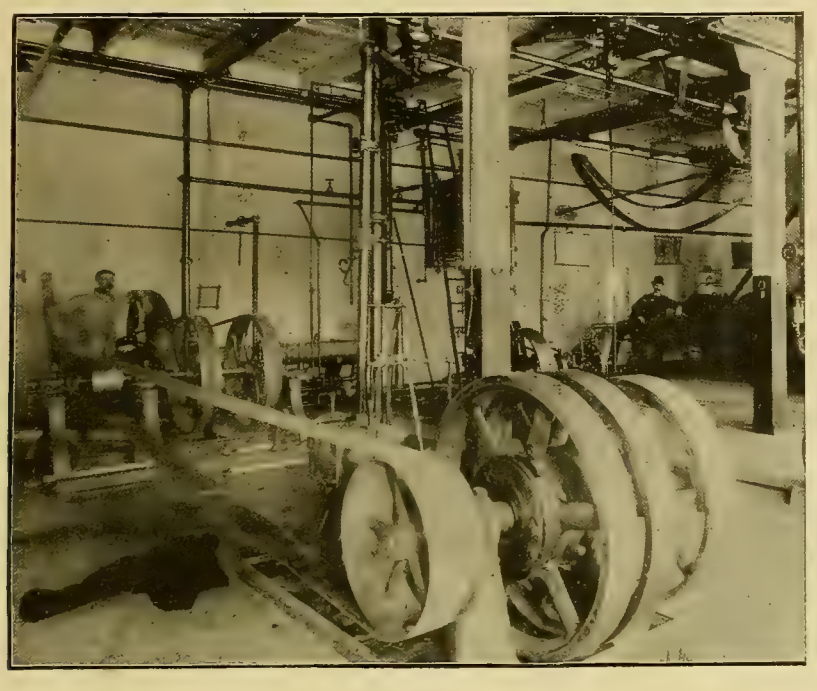
FIG. 4. EXPERIMENTS WITH HIGH TENSION CURRENTS AT BERLIN.

would assume the form of a pointed arc making a strong clattering noise, the tone of which would vary with the speed of the dynamo. The light of the arc displayed a great variation of colors, and would maintain itself even if the pole pieces were drawn apart to a distance of 4 inches. In using carbon poles the arc could be extended to 4.4 inches.

Further tests were made with samples of high insulation cables encased with lead, but without rubber for inside insulation. The cables were joined in the circuit and the lead casing grounded on the waterpipes of the room. The cables resisted 20,000 volts' pressure without sustaining any injury, while rubber insulated, lead encased cables would break down at a tension of 10,000 volts. The cuts are reproduced from the *Elektrotechnische Zeitschrift.*

Electrical Engineering at Cornell.

In the accompanying illustration is shown a view of the dynamo room at Cornell university, Ithaca, N. Y. The plant is located in Franklin hall, which was erected in 1883, and designed to accommodate both the physical and chemical departments. At the present time, however, the entire building is given over to the study of experimental physics. On the first floor is the large lecture room. In addition to recitation rooms, the cabinet of apparatus occupying three large rooms adjoining the lecture room, and the laboratories for practice work in general physics, applied electricity, photometry and practical photography, Franklin hall contains many rooms where original investigation can be carried on.



ELECTRICAL ENGINEERING AT CORNELL.

The dynamos that are used for lighting the university herewith shown are arranged to afford opportunity for complete "plant" testing by students of electrical engineering. They have been placed in the steam engine laboratory in the closest proximity to the sources of water and steam power. For the incandescent lighting of the shops, laboratories and offices, current is obtained from an Edison five hundred light dynamo. Arc lamps in shops and armory and on the campus are supplied with current from a 40 arc light alternator of the Westinghouse type.

The dynamos are so installed that they may be driven by water or steam power or both. Ordinarily the generators are operated by water power, furnished by the turbine wheel in the Ithaca gorge, and they are driven from the shop main line shaft by belting through a jack-shaft. This connection to the line shaft is made automatically when the machines are to be started, so that the line shaft does not have to be stopped. The jack-shaft is equipped with friction clutch pulleys of the most approved make, enabling each machine to be started and stopped independently. A straight line automatic engine is so arranged that it can be belted to the jack-shaft at any time without stopping, and is thus used ordinarily to help the water power over the maximum demand for power in the shops, and for lights between 5 and 6 o'clock. The dynamo room is in charge of Professor H. J. Ryan.

Circuit Closer for Burglar Alarms.

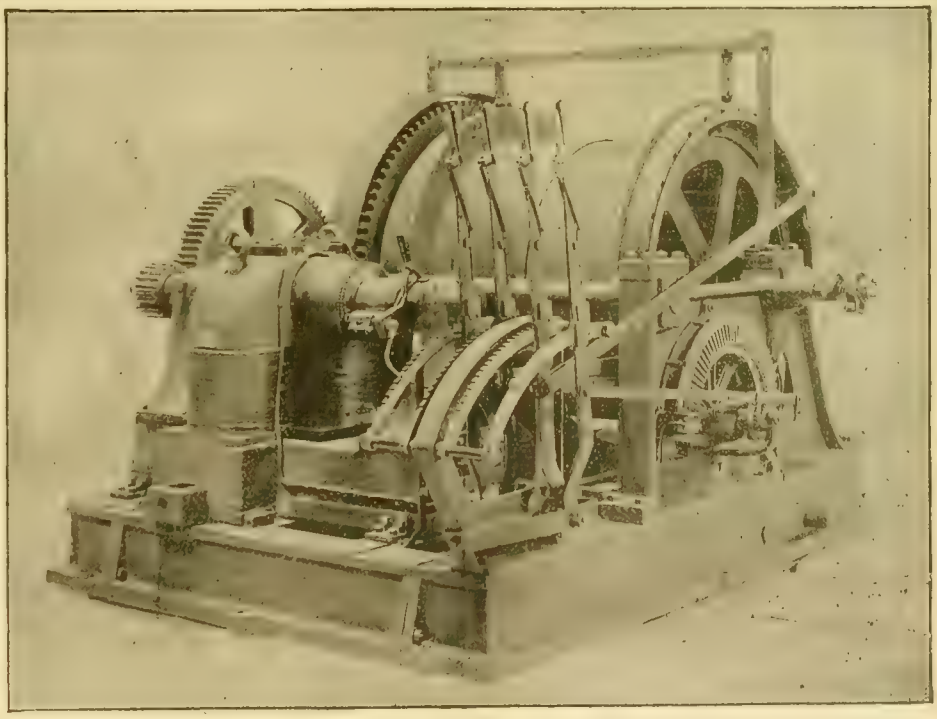
The device illustrated is a new form of circuit closer for burglar alarms, and consists of a pair of very thin strips of elastic metal, watch-spring steel being preferred. These strips are mechanically connected, but are insulated from each other by thin pads or washers at short distances. These strips may be of any desired length. They are inclosed in a tubular covering which prevents accidental displacement of the springs. The device thus constructed may be less than from one thirty-second to one fiftieth of an inch in thickness, and when placed under an ordinary carpet will give no indication of its presence by a ridge and will produce no appreciable wear on the carpet. The elasticity of the springs is sufficient to support the weight of the carpet without permitting the springs to come in contact, but when pressed upon by a heavy weight, as for instance when a person treads on the carpet just above one of these circuit closers, the springs will yield and come in contact, thus closing the circuit. A side elevation and a plan view of the device, which is the invention of Edwin A. Darling of Worcester, Mass., are presented in the cut.

CIRCUIT CLOSER FOR BURGLAR ALARMS.

Electric Hoists in Mine Haulage.

An advantage peculiar to the electric system of haulage for underground work is the ease with which the locomotive may be assisted on inclines by means of stationary electric hoists operated on the same circuit with the locomotive, thus permitting the employment of much smaller locomotives than would be possible otherwise. For instance, in a certain coal mine, a 40 horse power locomotive was necessary. As the entry was driven forward a fault in the measure was met, and the grade for a comparatively short distance so increased that the locomotive was unable to handle the work. An auxiliary stationary hoist was set up at the top of this hill to remedy the difficulty. For such work special apparatus is necessary, and the Thomson-Van Depoele Electric Mining company has placed on the market electric hoists designed for underground haulage plants. The illustration shows one of these which was recently made for a western coal mine. The plant originally consisted of one hoist, but its work and the results obtained by its use proved so eminently satisfactory that two other hoists were immediately ordered.

The outside dimensions of the hoist are nine feet by seven feet four inches, and the total height is nearly six feet. The motive power is furnished by a Thomson-Houston motor of 35 horse power, and wound for a potential of 440 volts. It is series wound and runs normally under load at a speed of 1,100 revolutions per minute. A speed reduction from the motor armature to the drum of 25½ is accomplished by one intermediate shaft with proper gears and pinions. This gives a rope speed of a little over 500 feet per minute, or 492 feet per revolution of the motor. The drum, which is mounted on a sleeve and is thrown into action with the large gear by a friction clutch, is four feet in diameter, with a 36-inch face. Its rotation, when running independently, is governed by two band brakes which extend around nearly the entire circumference of the drum. The outfit is equipped with five controlling levers, four of which are shown in the illustration. One operates the rheostat contact, one the drum clutch, two are brake levers, which are entirely independent, and the last operates the reversing switch, giving the drum, when thrown into action with the motor, positive motion in either direction of rotation. The controlling levers are all latched, and all within easy reach of the operator. The gears and pinions are noiseless, and carefully covered to prevent accidents, and the motor has self-oiling bearings.



ELECTRIC HOISTS IN MINE HAULAGE.

Olympia, Wash., is to have an electric street railway.

Wessel's Methods of Automatically Starting Constant Potential Motors.

To make clear the ingenious controlling devices illustrated in the cuts, it will not be amiss to explain a few facts which are well known to the majority of those handling constant potential motors.

When the armature of a constant potential motor revolves at a slow rate of speed its counter electromotive force is small, and hence it offers very little resistance to the flow of current through it. As the speed rises the counter electromotive force gradually rises also, until,

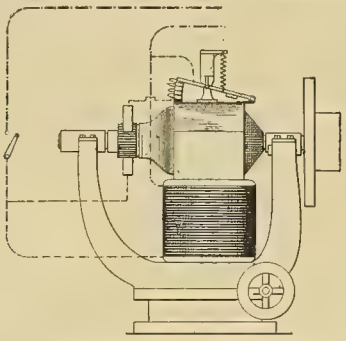


FIG. 1. STARTING CONSTANT POTENTIAL MOTORS

when the normal speed has been attained, there will be a normal flow of current through the armature. An increase of load, as it tends to reduce the speed of the armature, will cause an abnormally strong current to flow. The effect of this is the great liability to heat the wires and burn the insulation of the armature before it attains the requisite speed. To overcome this difficulty it has been the general practice to provide an artificial resistance placed into the armature connection to be gradually cut out by hand as the speed rises.

With a view of improving on the old fashioned practice and rendering automatic the movement of the rheostat contact lever, F. A. Wessel of Brooklyn, N. Y., has devised the three following methods:

Fig. 1 represents diagrammatically a mechanism through which the magnetism of the motor fields is employed to cut out resistance in series with the armature.

In this arrangement the rheostat lever is provided with an armature and is fulcrumed, as shown, just above, and in close proximity to the poles of the field magnet. A spring holds the lever away from the magnet, and a dash pot is inserted to prevent a too quick movement of the lever.

To start the motor it is only necessary to close the switch. The field magnet takes full current, and the armature begins slowly to revolve. At this stage of the operation injury to the armature is prevented by the resistance which is

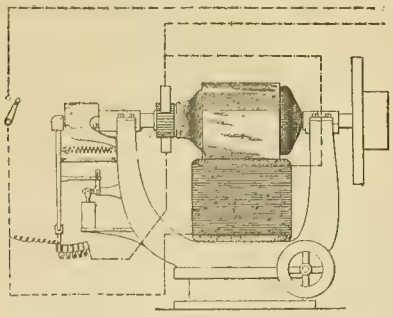


FIG. 2. STARTING CONSTANT POTENTIAL MOTORS.

included at starting in the shunt circuit. The field magnet now begins to attract the armature, drawing down the lever to cut out the resistance. This movement is gradual and so controlled by the dash-pot that a predetermined time elapses, sufficient for the armature to have acquired the requisite speed before the lever is completely drawn down, and all the resistance coils are cut out.

In a second method, Fig. 2, Mr. Wessel makes use of the tendency of an armature to center itself, so to speak, when revolving between the fields. This tendency he controls by a dash-pot, which retards the centering operation, and consequently the movement of the rheostat lever. When the current is cut off a spring returns the lever and armature to their initial positions and interposes the full resistance into the armature circuit, so that on starting the operation described will be repeated.

Fig. 3 illustrates a third method which is described as being particularly applicable to fan motors. Referring to the cut it will be understood that when the current is turned on, the fan revolving with the armature in the direction of the arrow, will tend to force the sliding armature shaft inward against the spring in the direction of the arrow. This causes the rheostat lever to move in the direction of its arrow. This tendency of the fan to force the shaft inward, and consequently, through the lever to cut out more or less of the resistance, is substantially proportional to the speed of the armature. The resistance interposed in the armature circuit will hence be entirely governed by the amount of resistance required by the armature to counteract the action of the current. A governor is thus provided.

National Electric Light Association.

The members of the executive committee of the National Electric Light association assembled at Montreal last week to arrange details for the coming convention. An unusually active interest is manifested this year in the Montreal meeting, not only by the electrical people of the United States but also of Canada, and it looks as though the attendance and objects of interest displayed will equal and even exceed those of former conventions. The association has been growing steadily during the last few years. It is the representative organization of the electrical interests of the country, and, owing to the very practical nature of its objects and labors and the immense aid it affords its members in a knowledge of the most economical and efficient solution of the every day problems in commercial work, is growing in favor.

The Victoria skating rink at Montreal will be used for the purposes of the exhibition, as it has been found that a smaller hall would not be sufficiently large to accommodate all who are anxious to obtain space.

Proposed South Side Electric Railway, Chicago.

An ordinance has been introduced in the Chicago city council granting a franchise to the newly organized South Chicago Street Railway company. This company proposes to operate an electric road on the following named streets: On Commercial avenue from Ninety-second street north to Seventy-ninth, thence to Coles avenue; on Commercial avenue from Seventy-ninth street to Cheltenham place, thence to Coles avenue; on Buffalo avenue from Ninety-second to Eighty-seventh street; on Eighty-seventh from Buffalo avenue to Superior avenue, thence to Eighty-third street, thence to Ontario avenue; on Ontario avenue to Ninety-ninth street, and thence to Coles avenue; on Coles avenue to Seventy-first street; on Seventy-first street to Yates avenue; on Yates to Sixty-eighth street, and on One Hundred and Sixth street from Ewing avenue to Indiana boulevard. The ordinance permits the use of either overhead or underground wires or storage batteries, and requires the cars to be heated from November to March inclusive. A $10,000 bond must be filed to secure the completion of the lines in two years.

Large Isolated Plant.

The Chicago *Herald* has decided to install a large isolated plant in its new building on Washington street, Chicago. It has awarded the contract to the Chicago Edison company for the incandescent plant, and the Thomson-Houston company for the arc lighting. The building is now being wired by these companies. There will be 50 arc lamps and 2,000 incandescent lamps.

Philadelphia Storage Battery Cars.

The first public exhibition of the new Wright and Starr system of street railway propulsion by storage batteries was given in Philadelphia recently. The *Times* of that city thus describes the trip: "The special car left the depot at Lehigh avenue shortly after four o'clock, containing a large number of councilmen and those interested in electrical affairs. The car was handsomely fitted. The propelling power is furnished by two rows of storage cells on each side of the car, placed under the seats, connected

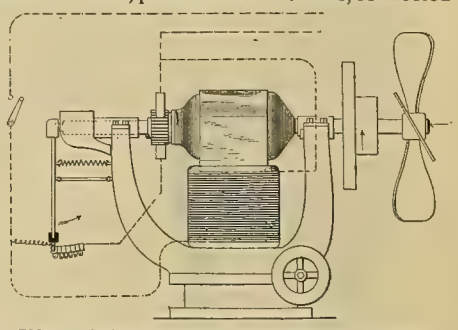


FIG. 3. STARTING CONSTANT POTENTIAL MOTORS.

to a motor geared directly to the wheels of the car. With the cells the car weighs 13,500 pounds."

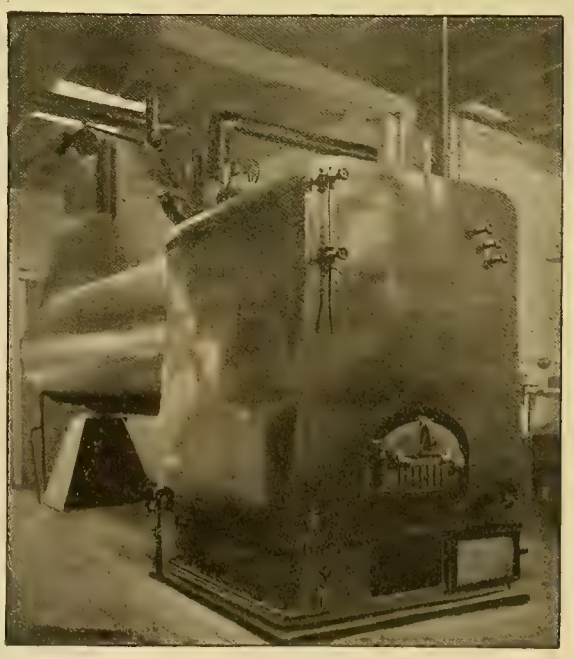
It is claimed that the car will be able to ascend a 10 per cent. grade with a full load, but the heaviest grade on the trial trip was one about 3½ per cent. The new system worked very satisfactorily on the trial trip, the car starting and stopping easily and readily with a load of about twenty passengers.

Electric Railway Litigation.

The Supreme Court of Ohio has reversed the decision of the Cincinnati Superior Court, which, at the petition of a telephone company, ordered an electric railway company to substitute the double for the single trolley system, it being asserted that the latter interfered with the use of telephone wires. The decision will affect all the larger cities in the state.

Frankfort Electrical Exhibition.

On the occasion of the recent opening of the Frankfort Electrical Exhibition, Finance Minister Miquel, as honorary president, took the opportunity of thanking the empress and the grand duke for the interest they had shown in the enterprise. After three cheers had been proposed by the burgomaster of Frankfort to the emperor, the Empress Frederick and the grand duke walked through the exhibition. Among other things they heard the very successful telephonic transmission of an opera by Delibes, which was being performed in the opera house at Munich, and then listened to an English song given by an Edison phonograph. The empress and the other distinguished visitors expressed great satisfaction with what they had seen. In the afternoon there was a banquet, and in the evening festive performances in the exhibition theater and in the opera house.

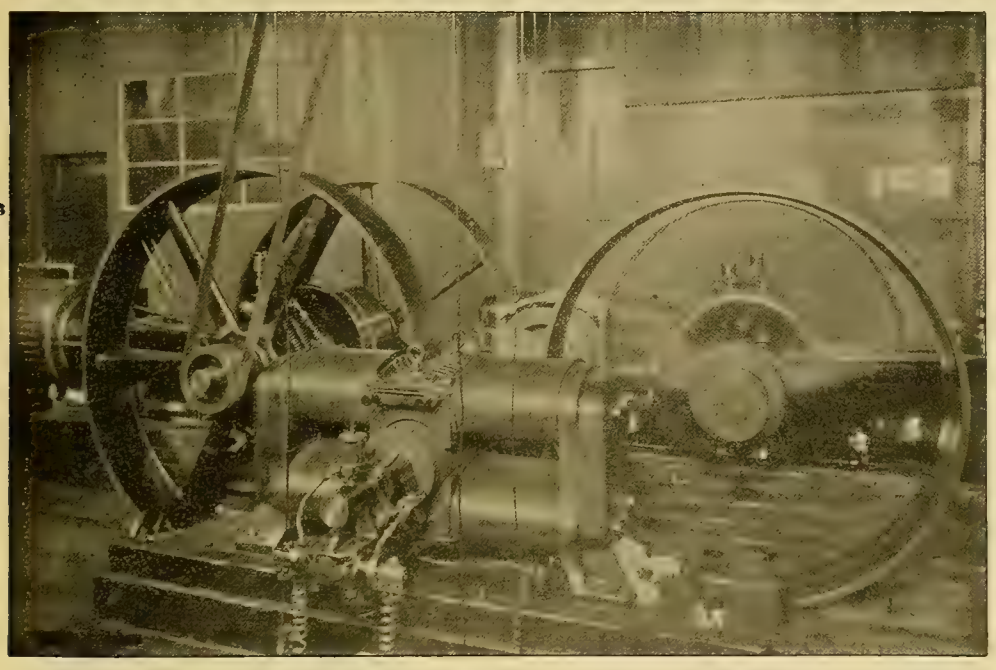


MILFORD STORAGE BATTERY CARS —VIEW OF BOILER ROOM.

Storage Battery Cars on the Milford, Mass., Street Railway.

The results attained during the last two years at Beverly, Mass., on the Beverly & Danvers street railway, have been sufficiently satisfactory to induce the Hopedale Electric Car company to equip the Milford & Hopedale line with the latest type of its appliances.

The cars have been in operation since April 14th. The length of the line is about six and a half miles, and is laid with thirty-five pound rail, made by the Pennsylvania Steel company. Tie rods are used every seven feet. The grades are as high as eight per cent., and include one of five per cent. for 1,500 feet, and one of eight per cent. on a curve of forty-five feet radius. The cars, it is stated, ascend this grade at a rate of about five miles per hour.



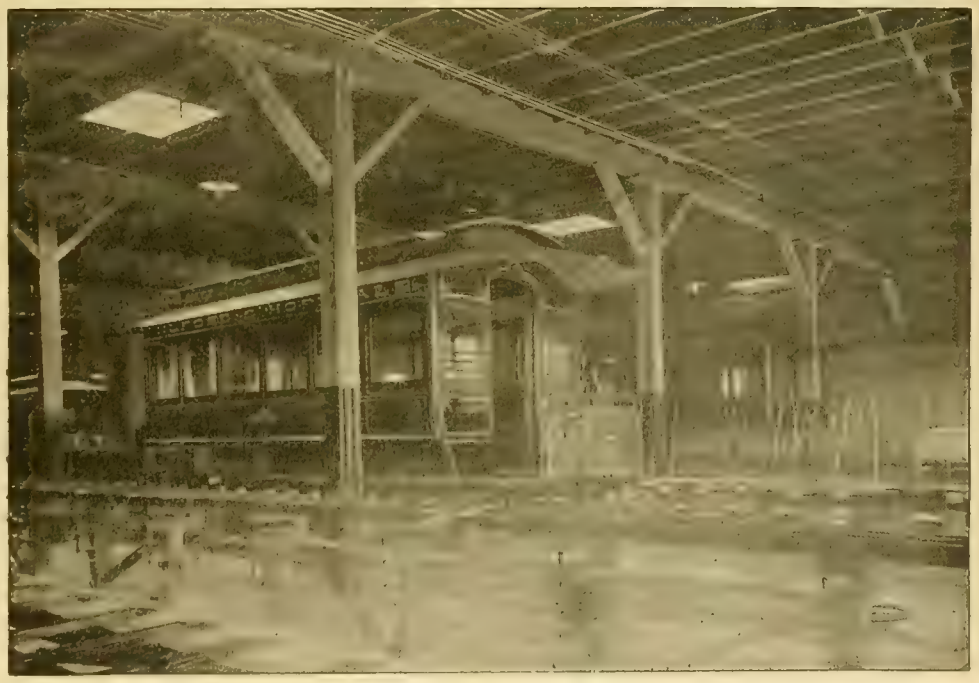
MILFORD STORAGE BATTERY CARS.—ENGINE AND DYNAMO ROOM.

The power station and car house are at the center of the line. The generating plant consists of two automatic Ball engines, one of 30-horse power and one of 60-horse power. These engines drive two twenty light Weston generators by means of Evans friction pulleys. The arrangement is such that either generator can be driven by one or both engines. The switch-board made by Holster & Cabot is most complete, and presents a handsome appearance. Weston current and pressure indicators are used.

The boiler, of a unique and special des'gn, was made by Edward Kendall & Son of Cambridgeport, Mass. It is of the Belpair type which was originally brought out in Belgium, but has been modified in a number of essential points by the manufacturers in this country. It is of tubular pattern, like a locomotive boiler, and no bricks are used in its setting, the boiler being simply mounted on piers. By this method of construction it is claimed that there is no space heated by fire which does not directly produce steam. A fire arch is used above the furnace, and every part of the boiler is accessible.

The car house and storage room are connected directly with the power house. The racks for holding the batteries, are made adjustable in height by means of screws connected with sprocket chains and operated from one point. This arrangement facilitates the removal from and the replacement of the storage cells in their positions under the car seats. The connections from the cells to the car and rack are made automatically when they are set in place. The batteries, which are of the Johnson type, are arranged in trays of twelve cells each, and weigh thirty-two pounds per cell, making a total weight for the battery equipment of 4,480 pounds. The number of cells for each car is 140. Three sets, or 420 cells, are generally charged at a time, though the equipment allows of charging as few as seven or eight at once. The current used is from five to eighteen amperes with a voltage per cell of about two and one-fifth. From three to four hours is required for charging.

The cars were made by the Ellis Car company of Amesbury, Mass.; six of them are 16 feet 11 inches long, and seat twelve passengers on a side. They are mounted on Bemis trucks. Two 7½-horse power motors with single reduction gearing run in oil, are used on each car. An essential portion of the system is the controlling switches, two of which are used, one at each end of the car. The inside cylinder of this switch is made of the best vulcanized rubber with brass connections. Each switch has six different positions and regulates the current flowing through the motors by changing the connections of the batteries so as to vary the potential. To put the switch in circuit it is necessary to insert a key at the base, and this can only be done when the regulator handle is at the zero position. Through this arrangement there is no danger of accidental short circuiting. Another valuable feature of the car is an electric brake which is under complete control of the motor man by means of a knob at the top of the switch box. The braking is done in such a manner that the energy of the car while going down grade can be used to operate the motors as dynamos. It is claimed that in actual practice it has been found possible by this device to return to the batteries from fourteen to twenty-two per cent. of the energy expended in operating the car.



MILFORD STORAGE BATTERY CAR HOUSE AND CHARGING ROOM.

Only two cars at a time are being run at present, and each car covers twenty-four miles without re-charging. During the last thirty-seven days the cars made 2,736 miles, and carried 13,200 passengers.

The cars run at present sixteen hours a day, or six hours longer than the generating station is kept in operation. The time required to ascend the five per cent. grade with the length of 1,500 feet already referred to, is stated to be three minutes, with an average amperage of 72 and voltage of 145.

An example of the capability of the system was shown during the early part of April when one of the cars, in trying to pass a curve which was not laid with grooved rails, ran off the track into the sand. This car was replaced on the track by its own motive power within twenty minutes. The cuts are from the *Street Railway Journal.*

Edmond Becquerel's Death.

Edmond Becquerel, the eminent French electrician, whose death was recently announced, was born in Paris, March 24, 1820. His father, the veteran Antoine Cæsar Becquerel, the friend of Davy, Faraday, de la Rive, Ampere, Arago and all the notabilities of the former generation, died at the age of ninety, in 1878. From 1823 to 1863 he had worked incessantly at electro chemistry, atmospheric electricity and kindred problems; and in many of the later of those researches his son Edmond was associated with him. In 1856 the latter made a very complete study of the electromotive force and internal resistance of primary batteries. At one time he gave much attention to the subject of magnetism, and conducted a series of researches on the diamagnetic properties of bodies, using for that purpose an electro-magnet of a size which at that date—1846—had scarcely been equaled in power. M. Becquerel also made exhaustive researches into the causes and effects of light, and his treatise on this subject is considered a standard authority.

Effect of Electrical Discharge on Steam.

Before the Royal Meteorological society of England, recently Shelford Bidwell, M. A., F. R. S., exhibited an experiment showing the effect of an electrical discharge upon the condensation of steam. The shadow of a small jet of steam cast upon a white wall is, under ordinary conditions, of feeble intensity and of a neural tint, but if the steam is electrified the density of the shadow is at once greatly increased, and it assumes a peculiar orange brown hue. The electrical discharge appears to promote coalescence of the exceedingly minute particles of water contained in the jet, thus forming drops large enough to obstruct the more refrangible rays of light. It is suggested that this experiment may help to explain the intense darkness, often tempered by a lurid yellow glow, which is characteristic of thunder clouds.

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F. L. PERRY, - - - - - - - - - - - - }
W. E. KEILY, - - - - - - - - - - - }
J. L. BAKER, - - - - - - - - - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE contract for the electrical building at the World's Columbian Exposition was awarded during the week as was anticipated. There is now no question about the dimensions of the proposed structure. The original plans will be followed and the electrical people will be obliged to make the best of the facilities at their disposal. Despite the earnest protest of the entire fraternity it has been decided to make the electrical display in a building much smaller than the requirements of the department demand.

This will prove a great disappointment to the electrical interests, as it was hoped even at the last moment that the directors would cause the plans to be changed so as to provide for a larger building. Chief Barrett made a strong fight, but was unable to secure the desired change, owing to the fact that the plans had so far progressed that any serious alteration such as that contemplated in the demand of the Electrical Department, would necessitate a complete rearrangement of buildings and allotments. The whole trouble was due to the failure of Chief Burnham of the Construction Department, to consult the electrical interests as to the amount of space a representative display of the industry would occupy. Throughout the entire proceedings he has studiously disregarded the demands of the electrical people and has opposed every attempt to change the original design.

While it is true that the electrical people have not been successful in their efforts to secure a larger building and a united display they have gained many points in the controversy and have reason to congratulate themselves. It is true that the generating plant will be situated some distance from the electrical building, but it is also equally true that Engineer Gottlieb's pet scheme for conveying steam from the "machinery annex" to the electrical building, a distance of 1500 feet, has been abandoned and in its place has been substituted an electric system which will furnish power not only in the electric building, but also throughout the grounds. An immense generating plant will be installed in the "loop" and current will be supplied from this point for the illumination of buildings and grounds and the operation of machinery in all parts of the great fair. This is an important advantage and one that was scarcely expected even though electrical engineers realized that it would be to the interest of the exposition to make this arrangement. At present the plans for an underground system of distribution are being prepared, and visitors to the Fair will no doubt have an opportunity of seeing a model system in practical operation. It is certainly appropriate that Chicago, the first city in the world to make the radical departure of adopting underground work on an extensive scale, should make a special display at the Fair showing the advancement that has been made in this department.

This, however, is not all. The agitation for an electrical building of adequate dimensions aroused considerable interest among the directors and they determined to utilize electricity wherever possible. One of the directors expressed the conviction that the fair would develop into an immense electrical display. It is nevertheless to be regretted that the directors could not be prevailed upon to change the plans for the building devoted to electricity.

THROUGH a London paper news comes from Italy that an elevated electric railway of unprecedented height is about to be built at Naples. It is stated that the towers supporting the rails will reach an altitude of 100 metres, over 300 feet. If this is true—doubtless there will be many disposed to doubt the accuracy of the statement—the success of this extraordinary undertaking will be watched with much interest by electrical and mechanical engineers the world over.

THE irrepressible conflict between the electric railway and telephone interests still wages. The latest manifestation of the legal aspects of the controversy is reported from Cincinnati, O., where the Supreme Court of the state has overruled a decision made by the Cincinnati Superior Court in favor of the telephone people, by which the street car company was ordered to replace the single trolley system by double trolleys, on the ground that the former interfered with the telephone wires. This decision will undoubedly have the effect of giving renewed confidence to the overhead trolley advocates. Those who are most interested in the telephone and electric railway systems have advised a compromise, and it is believed this will eventually be effected. Both the telephone and the electric railway have enough to do resisting outside interferences without fighting each other.

MUCH dissatisfaction is expressed in New York over the recent proceedings of the Board of Electrical Control and the subway companies. The litigation growing out of the misunderstanding between the several interested corporations and the board has not served to add luster to the fame of the commissioners. The daily press is a unit in declaring the board an inefficient body, and all who have had business relations with this institution will heartily approve this expression.

IN the discussion of the paper before the institute on rapid transit in cities, reported in this issue, Prof. Forbes calls attention to the fact that the English have apparently outstripped the Americans in rapid transit matters. We have heretofore called attention to the progress that has been made on the other side, especially in the London underground system It appears that our friends across the water are thoroughly enjoying the situation, and taking all the comfort possible from the thought that they have at last surpassed their American rivals. One cannot wonder at this. It is a rare spectacle and, probably, the one occasion of a lifetime for our English friends.

THE subject of lighting railroad tunnels is once more before the people of New York, the railroad commissioners having resumed their inquiry into the best methods of lighting and ventilating the Fourth avenue tunnel in New York City. There is a wide difference of opinion expressed by the experts who have been heard. Some advocate arc lights, others prefer incandescent, but the engineers oppose any kind of electric lights as they say they could not see the signal lights used in the tunnel owing to the brilliancy of the electric light. The commissioners have not yet filed their final report and it is probable that another attempt will be made to secure a system which shall be acceptable to the railroad companies and serve its purpose. The railroads seem to be particularly unfortunate in securing a practicable system. They profess to be eager to secure such a system but they have yet to discover one. Authorities in other states should watch the proceedings in New York and take advantage of the information presented by the experts.

IT has been noticeable of late that the tendency of English manufacturers is toward the construction of combination electric lighting plants rather than to the building separately of dynamos and engines. Almost every week the London technical papers describe an outfit similar to the one presented in another column. The advantages of the combination plant are many, and it would seem as though there should be a sufficient demand in the United States for such machines to warrant their introduction by our more enterprising concerns. Several American dynamo makers have exploited combination plants for ship lighting service, and we call to mind one firm at least which is employing dynamo's directly connected with engines for central station work, but there seems outside of these to be little or no appreciation of the peculiar adaptability of such equipments for isolated plants in cities. In Chicago, for instance, in the business portion of the city where, it may be said without exaggeration, space is sold by the square foot, one can not but believe that the combined engine and dynamo would meet with favor from a larger number of those who wish to install an isolated lighting system. Go into the cellars of Chicago's commercial buildings, and how much space do we find wasted in order that a proper length of belt may be obtained between engine and dynamo? It should be enough to call attention to this bad feature in our present practice to insure its remedy. Which of our manufacturers will, by imitating the English, take advantage of this latent demand?

Method of Magnetic Separation.

A device for separating magnetic from non-magnetic substances is shown in the accompanying illustration. This is particularly applicable to the separation of iron particles from magnetic sands. It is necessary to establish a flow of water in which the materials are carried in divided form, thus producing in the stream two flowing strata, in one of which the magnetic material is maintained by magnetic action opposed to another force, as gravity, while the non-magnetic materials are forced or main-

METHOD OF MAGNETIC SEPARATION.

tained in another stratum, and diverting the stratum of flowing liquid and magnetic material through a channel separate from that through which the stratum holding the non-magnetic material passes.

A glance at the cut will show the arrangement of magnets above the trough and in close proximity to the cover. The magnets may be permanent or electro-magnets, and it is preferable to give them a movement in the direction of the arrow along the upper side of the trough. To accomplish this they may be mounted upon a belt, carried upon two wheels or drums as indicated.

At the outlet end of the conduit or trough two openings are provided on different vertical planes, one of which is adapted to direct the water near the top of the conduit into a separate receiver from that into which the water at the bottom of the conduit or trough passes. The lower opening preferably takes in the greater part of the moving stream, especially where the magnetic substances form a small proportion of the total solid material. Water or other liquid under pressure or head may be introduced at the upper end of the trough or conduit. A slight inclination is given to the trough or conduit to assist the flow.

It will be noticed that there is an openwork basket or receiver reaching nearly to the bottom of the trough and in the path of the flowing liquid. Into this the divided substance—such as magnetic sand—is introduced by means of a hopper. The openings in the receiver are of sufficient size to allow the sand or other substance in divided form to be washed out freely and carried along by the stream of liquid flowing through the conduit. Receivers having different sized openings may be used for materials of different degrees of fineness. The device is the invention of Hemyl Townsend of New York.

Tapping Telegraph Wires Prohibited.

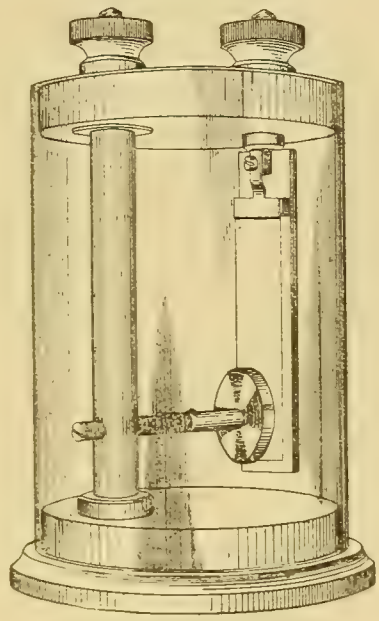
The Illinois legislature last week passed a bill amending the present act prohibiting the tapping of telegraph wires. It provides that any person who shall unlawfully, intentionally, and maliciously injure, molest or destroy any telegraph line, wire, or cable, pole, pier, or abutment, or the material or property belonging thereto, or any unauthorized person who shall unlawfully, willfully and maliciously cut, break, tap, or make any connection with any telegraph line, wire, cable or instrument, and unlawfully or willfully and maliciously copy in any unauthorized manner any message, either social, business, sporting, news or commercial reports passing over it in this state; or who shall willfully and maliciously prevent, obstruct or delay, by any means or contrivance whatsoever, the sending, conveyance, or delivery, of any authorized communication by or through any telegraph line, wire, or cable under the control of any telegraph company doing business in the state, or who shall willfully and maliciously aid, agree with, employ, or conspire with any unauthorized person or persons to unlawfully do or cause to be done any of the acts herein before mentioned, shall, on conviction thereof, be deemed guilty of a misdemeanor and be punished by a fine of not less than $300, or more than $500, or imprisonment in the county jail not exceeding one year, or both, at the discretion of the court having cognizance thereof.

Prosecution under this act shall be by indictment in any court having criminal jurisdiction.

This bill is aimed at bucket shops and crooks mainly, who have heretofore interrupted messages and held them back until they could take advantage of the knowledge thus obtained.

An Electrostatic Safety Cut-out.

The device shown in the accompanying illustration is a brass cylinder fixed on an ebonite base, and closed at the top by an ebonite cap. A solid brass rod runs from top to bottom, and near the bottom, and at right angles to it, is fixed a smaller adjustable rod, terminating in a flat head. Opposite this flat disk there is a brass strip secured to the ebonite cap. From the top of this brass strip hangs a piece of gold or aluminum foil. The foil and strip are connected to earth, and the solid brass rod is connected to the circuit to be protected. Should the difference of potential between the foil and



ELECTROSTATIC SAFETY CUT-OUT.

the terminal opposite it, attain more than a certain amount, electrostatic attraction will cause the foil to touch the disk, and thus ground the circuit. This apparatus, which is a modification of the Cardew earthing device, is constructed by Drake & Gorham, London, England. The cut is from the London *Electrician*.

University of Pennsylvania.

The improvements in the University of Pennsylvania now under way include modern methods of heating and ventilating of existing buildings and providing for that of new buildings, either in process of construction or to be erected in the immediate future, and provisions for the growing demands of the department of mechanical engineering. Heretofore each building has been heated by a separate plant in its basement, and has been lighted by gas. It has been decided to build a central heating station, with a present boiler capacity of 1,200 horse power, from which to heat all the buildings, at present eleven in number. In addition the buildings are to be lighted throughout by electricity, and to be thoroughly ventilated by the use of large ventilating fans in the basement, which will probably be driven by electric motors. The engines and dynamos for this purpose are to be placed on the ground floor of a separate building, the two upper floors of which will be used by the mechanical engineering department. The entire plant is to be put in, not only for the purpose of furnishing light and heat in the most economical manner, but in addition it is designed especially for the purpose of instruction, for which it will at all times be available.

Steam will be generated at 100 pounds, used in the engines, and, when exhausted, will be used for heating, so that the power used in generating electricity for lighting will be obtained at a minimum of cost, and the lighting of buildings will be very much better than at present. Owing to the configuration of the land, it is possible to get a gravity return of the water from the condensed steam from all the separate buildings to a well in the boiler house, from which it will be pumped into the boilers.

Separated from the boiler house by a distance of fifteen feet is the building for the mechanical engineering department, which will contain in its basement the engine and dynamo room. The building will at present have a length of eighty feet and a width of forty-five feet, with a provision for any desired extension in the future. In the dynamo room will be located two 100 horse power compound engines and two engines of the high speed type.

The electric lighting will be partly on the alternating and partly on the direct current system. Two 500 light 1 000 volts alternating and four 500 light direct current dynamos are to be employed. As with the boilers and engines, it is proposed to use several types of American machines. The direct current machines will be compounded. These will also be so connected to their switchboard as to run separately or in multiple. One alternating and one direct machine will be connected by belt to each of the compound engines; the remaining dynamos will be driven each by its separate engine. By this arrangement either dynamo or either engine may at any time of the day be used for experiment or instruction, as is the case with the boilers. This plant, in addition to the machines already belonging to the department, and including the motors for driving fans, will be large and more comprehensive than that of any institution in the country. Students will have actual practice in the handling of the entire apparatus and will be enabled to obtain a very considerable familiarity with the details and peculiarities of the systems of the principal American manufacturers.

On the third floor will be the electrical engineering laboratory, occupying a space of 1 600 square feet. On one wall a special switch-board will be placed, so arranged that any or all of the dynamos can be connected at will with any measuring instrument or apparatus in the laboratory. It will be provided with a photometric room for measurements upon both arc and incandescent lamps, with the many different types of which the department is supplied. The apparatus for electrical measurement is already quite extensive, and is continually and rapidly increasing. The department library contains a large number of the modern works upon mechanical and electrical engineering.

Electric Riveting Interference Decision.

To the Editor of the WESTERN ELECTRICIAN:

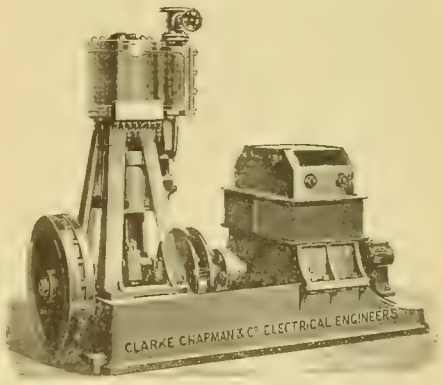
The communication from Elias E. Ries, published in the WESTERN ELECTRICIAN of May 16th, regarding a recent decision in the Thomson vs. Ries electric riveting interferences implies that this decision of the examiner of interferences is final, and the statement is made that "the claims involved in the decision cover broadly and fundamentally the art of riveting by means of electricity and the apparatus necessary for successfully operating the same."

The decision referred to by Mr. Ries was that of the lowest tribunal in the patent office, from whose conclusions there are two appeals. We believe the decisions of the examiner of interferences are wrong, and an appeal has already been taken and argued. This interference relates merely to a refinement of the inventions of Prof. Thomson on which he has secured patents which cover broadly the subject matter of the interference to which Mr. Ries refers. No electric riveting can by any possibility be done without infringing patents already issued to Prof Thomson, as a reference to those patents will show

Yours truly,
THOMSON ELECTRIC WELDING CO.
Boston, June 2, 1891. per H. N. Sweet.

English Engine and Dynamo.

The cut presented herewith represents a combined steam engine and dynamo constructed by



ENGLISH ENGINE AND DYNAMO.

Clarke, Chapman & Co., of Gateshead-on-Tyne, England, and exhibited at the Royal Naval exhibition. The plant, which is compactly arranged, consists of an engine and dynamo coupled directly and bolted on the same bed plate. The engine has a cylinder 8½ inches in diameter with an 8 inch stroke, and is of sufficient power to drive a dynamo giving an output of 9,000 watts. The makers have special appliances for machining the frames and cylinders of these engines, whereby the main bearings, motion bar seatings, motion bars, cylinder, and cylinder stuffing boxes are all bored at one setting. The cylinder flanges are faced at the same time, thus insuring all these surfaces being perfectly true with one another. The main bearings are of ample length and diameter, the extreme pressure being 220 pounds per square inch, while that on the crank pins is about 450 pounds and on the motion bars only 50 pounds, when fully loaded with a steam pressure of 120 pounds per square inch. The dynamo, which is of the drum type, is constructed to furnish 150 16 candle power lamps at 65 volts. The cut is from *Industries*.

Present Theories Concerning the Nature of Electricity.[1]

By Prof. C. S. Cook.

Among the unsolved problems of physicial science none are more fundamental and of greater import than the questions as to the nature of matter, ether, electricity and gravitation. A full understanding of the nature of ether would no doubt give the solution of all the other problems named, as well as others not named. Faraday was always convinced that there was some relation between gravitation and electricity, although none has been discovered other than the undoubted fact that their manifestation is most intimately identified with a common medium, the ether. As Prof. Trowbridge says, "It is somewhat strange that although we are so curious in regard to electricity, we seldom reflect that gravitation is as great a mystery as electrical attraction."

Little is to be gained by considering the older and familiar so called theories, which were often formulated chiefly to furnish scientific nomenclature, and were framed from motives of convenience rather than for acceptance, and were for use, not for belief.

We must, first of all, try to gain some notion as to that all pervading medium known as the ether. We are sure that such a medium exists. What we have been accustomed to call the "forces of nature" are manifested through the ether just as much as through matter. We should no longer talk of the "hypothetical" ether any more than we should talk of hypothetical matter. It is just as certain that the one medium exists as the other. Moreover they are equally important in nature.

Many effects are observed involving transmission across space entirely devoid of matter, or at least where the amount of matter is surely inadequate to the effect. For example, what we call the "attraction" of gravitation the "attraction" of electrified bodies, magnetic induction and radiant energy. As we receive light from the remotest part of the universe, there must exist a medium of corresponding extent, which has been commonly called the luminiferous ether. Are we to suppose that this luminiferous ether serves also for the propagation of gravitation, electrical and magnetic influences? It used to be customary to assign a separate ether to each group of phenomena. As Maxwell says, "Æthers were invented for the planets to swim in, to constitute electric atmospheres and magnetic effluvia, to convey sensations from one part of our bodies to another, and so on, till all space had been filled three or four times over with æthers. It is only when we remember the extensive and mischievous influence on science which hypotheses about æther used formerly to exercise that we can appreciate the horror of the æthers which sober-minded men had during the eighteenth century. To fill all space with a new medium whenever any new phenomenon is to be explained is by no means philosophical, but if the study of two different branches of science has independently suggested the idea of a medium, and if the properties which must be attributed to the medium in order to account for electro magnetic phenomena are of the same kind as those which we attribute to the luminiferous medium in order to account for the phenomena of light, the evidence for the physical existence of the medium will be considerably strengthened. If it should be found that the velocity of propagation of electro-magnetic disturbances is the same as the velocity of light, and this not only in air, but in other transparent media, the combination of the optical with the electrical evidence will produce a conviction of the reality of the medium similar to that which we obtain, in the case of other kinds of matter, from the combined evidence of the senses." It is noteworthy that Maxwell speaks of ether as a "kind of matter," but this is not usual. While the ether appears to have some of the properties of ordinary matter, notably inertia and elasticity, it possesses a combination of properties which we have not associated with matter. If we accept ether as a form of matter, we must greatly modify our definitions and notions, and enlarge our conception of matter. In the present state of our knowledge, unfortunately, it is not possible to assign to the ether with confidence all the properties it must possess. In fact, it must be said that comparatively very little is known as to its properties, and we have nothing but surmises as to its constitution. None the less most encouraging progress has been made, and as a consequence some things are known, and it is possible to frame tentative conceptions intelligently, which may and probably will require modification, while we may reasonably hope that they embody much truth.

Before accepting the existence of a new medium in space, a medium endowed with unfamiliar properties, every effort must be made to show that no form of ordinary matter is able to perform the functions assigned to this luminiferous ether. The ease with which bodies traverse it, the fact that very light bodies of great size can sweep through it at very high velocities without appreciable retardation, seems to make it clear that if the ether is a form of ordinary matter it can only be composed of matter in the gaseous state Our experience scarcely allows us to associate such great mobility and small density with the solid and liquid states

Mr. Toloen Preston has given much study to the theory of the ether, and arrives at conclusions which are full of interest. He assumes that the ether is composed of particles of a much smaller size than the atoms of matter, these particles being endowed with very high velocities as are the atoms of a gas, but the ethereal particles having a much higher velocity. While the particles of hydrogen gas at ordinary temperature have a mean velocity of about a mile a second, the ethereal particles must have velocities of something exceeding the velocity of light, or 186,000 miles per second. This is an inferior limit which may be almost indefinitely exceeded apparently. In this theory there is this important difference between a gaseous and ethereal medium, namely, that while the particles of gases are near each other, and so suffer constant collisions, the much smaller ethereal particles are at such great distances from another that collisions rarely occur and the mean free path becomes a distance of a magnitude such as separate the planets from one another.

The condition which Preston says must be met by the hypothetical medium, and which he attempts to show might be met by a medium of atomic and ultra-gaseous character are as follows: "As a first condition we require the existence of a physical agent capable of transmitting motion to a distance with speed and facility, in order to refer to physical agency all the effects at present brought under the theory of 'action at a distance.' As a second condition this physical agent must be shown to be capable of inclosing a store of motion of a very intense character, competent to produce all those forcible molecular and other movements of matter exhibited in such effects as the phenomena of chemical action, the 'electric' motions, combustion, the remarkable development of molecular motion observed in the case of explosive compounds, such as the explosion of gunpowder, and other numerous and striking phases of motion witnessed on all sides. Thirdly, this physical agent will have to be proved to be competent to exert an intense pressure upon the molecules of matter, and consonant with the very forcible character of the static effects exhibited in 'cohesion,' and the stable aggregation of molecules generally; and finally, these several physical qualities of the agent will have to be shown to be capable of existing harmoniously together, and consistent with an extremely low density in the agent."

The first condition of speedy transmission of impulses he meets by assigning to the particles of the agent a normal speed of something exceeding the velocity of light.

The second condition compels us to accept a pressure of not less than 500 tons per square inch, a pressure exerted on the molecules in such a way that our senses are powerless to recognize it. He arrives at this figure for the pressure from considerations founded on the tenacity of steel. The above values of the velocity of the particles and the pressure of the medium lead us to assign a density to the $\frac{1}{5\,264,800}$ agent of that of the atmosphere, a density less than that of the best vacuum obtained. Each cubic foot of the medium should have a store of energy in virtue of the motion of its particle amounting to not less than 10,700 foot-tons. While we have no right to affirm that such striking results are *a priori* impossible or incredible unless they can be shown to lead to results which our senses can disprove, yet there are great difficulties in the way of accepting theories affirming the gaseous nature of the medium. Especially serious is the difficulty in accounting for the fact that the vibrations of light are transverse, a kind of vibration of which gases are necessarily incapable. However, Maxwell has suggested that something of the nature of a rotation of the ether particles might possibly give results permitting of the application of the same equations now in use for expressing the displacement in the present theory of transverse vibration.

The larger number of the writers on electrical theory make use of the conception of an ether which has little resemblance to gases, but if likened to any kind of ordinary matter is most commonly said to resemble a thin jelly. This is clearly an attempt to conjoin the fluidity demanded by the free motion of the heavenly bodies with the rigidity demanded for the transmission of transverse vibrations. It is probably wiser not to insist too much on such comparisons, and to recollect that the ether must confessedly have properties unlike those of ordinary matter.

The prevailing tendency, at least among English writers, is to make use of a medium more or less remotely resembling a jelly. Whether this agent is molecular is not decided. If such particles exist they are much smaller than the atoms of matter. Some writers hold that it is continuous, and is not molecular in any sense, that it has no parts and is strictly homogeneous. Such a medium may or may not be compressible. It is often affirmed that matter must be composed of parts separated by distances, otherwise it would not be possible to compress it. But there is no good reason why we may not assume that a medium containing no cavities is compressible.

Every part of such a medium may be conceived of as elastic and capable of compression. However, there is reason to believe that the ether is really incompressible. A light wave contains only transverse vibrations, which can only be explained by supposing that the ether possesses elasticity of figure without elasticity of volume. The intense vibration of incandescent molecules would give rise to vibrations of the surrounding medium in all directions, to longitudinal as well as transverse, and the absence of the former would be explicable by supposing the medium incompressible. If this is the case, no true vibrations occur, there is no true displacement, but only a periodic alteration or alternation of stresses. Another reason for ether to be incompressible will be considered when we discuss the relations between that medium and electricity.

In order that a medium may transmit a vibration it must possess two fundamental qualities, density and elasticity. The velocity with which the impulse will be propagated will be equal to the square root of the elasticity divided by the density. The ether must certainly possess these two qualities. As the velocity of light is known to be very great we are sure that the elasticity of the ether is very great, or the density very small, or that both these conditions exist. As the velocity of light is uniform in the inter-stellar spaces, the density and elasticity are uniform and are not affected by gravity as are these properties of our atmosphere. As light traverses transparent bodies at velocities often much less than that in vacuo, it is evident that the ether within bodies is modified in its properties by the presence of the molecules of matter, and apparently either the density is increased or the elasticity diminished. Fuesneli assumes that it is the density which is modified, McCullagh, that it is the elasticity. Fuesneli's hypothesis is the familiar one, yet it is not tenable in its literal interpretation if the ether be assumed incompressible.

It has been shown experimentally that of the ether within a body, a definite portion is "free," that is, it does not share in the motions of the body, while another portion is in some way entangled among or bound to the molecules, and moves with them. Frizeau has shown (and his results have been verified by Michelson) that when a beam of light is transmitted through a stream of water, if both are moving in the same direction the velocity of the light is greater than if they are moving in opposite directions. However, as the increase in the velocity of the light due to the motion of the water is found to be less than the velocity of the water, it is concluded that only a portion of the ether is transported with the water.

With all our ignorance concerning the ether this much we have seen is almost certain. The medium possesses inertia (consequently density). It possesses elasticity of figure; it is freely traversed by matter, a portion of the ether flowing freely with no appreciable friction through the pores, or inter molecular spaces of the body, while another portion is in some way apparently bound to the molecules, and moves with them.

No doubt every one present has said to himself that it is about time something was said about the subject of the paper, and that electricity should receive some attention. We all know that it often occurs in mathematics that two problems very different in their statement are really closely related, and the solution of the one is the solution of both. Now there is little doubt that the ether puzzle is the same as the electricity puzzle. According to some ether and electricity are one and the same.

We are very familiar with the statement that the physical universe contains only two things, matter and energy. We know well that electricity is not a form of energy, and no one seems inclined to consider it material; must we say that the physical universe is made up of three things—matter, energy and electricity? It is surely better to say that the physical universe contains energy, matter and ether, and try in some way to identify the latter with electricity.

By far the most carefully worked out exposition of the results of recent thought and research is the well known book by Prof. Lodge, published some two years ago. (Modern Views of Electricity).

Prof. Lodge's views on the point just raised are but given in his own words as follows: "Few things in physical science appear to me more certain than that what has so long been called electricity is a form, or rather a mode of manifestatis of the ether. Such words as 'electrification' and 'electric' may remain; 'electricity' may gradually have to go." It can be noticed that whereas in the earlier part of the book the word electricity occurs frequently and the word ether seldom, in the latter portion this order of frequency is inserted. A rough and crude statement adapted for popular use is that electricity and ether are identical; but that is not all that has to be said for there are two opposite kinds of electricity, and there are not two ethers. But there may be two aspects of one ether, just as there are two sides to a sheet of paper, or two aspects of a transparent clock face; and similarly positive and negativ eelectricity maybe two aspects, or, as I have sometimes called them by chemical analogy, 'components of the ether.' Anything that can be sheared (and ether is sheared by every electromotive force applied to it) must consist of two parts sufficiently different to be displaced in opposite direction. If this statement is vague, it is because the knowledge of the structure of the ether is vague, not because the relationship of the electricity to ether is uncertain, or will be anything but definite so soon as we know the constitution of the ether more precisely. Vague at present our knowledge of the ether is, but not so vague as these lines may suggest. That which has now to be investigated is not the nature of electricity, but the nature of the ether, and a question it is indeed; *the* question of the physical world at the present time. But if it is not unanswerable; it is, in my belief, not far from being answered. And it is probably a simpler question than the supplementary and next subsequent question, What is matter? It is simpler, partly because ether is one, while matter is apparently many."

Electricity manifests its presence in four ways: We recognize electricity in charges, in currents, in magnetism, and less familiarly as yet in radiant energy, that is "radiant heat" and light. Let us see if we can get some notion of the part played by the ether in each of these cases.

Let us note, however, the most significant fact that we are to take a very unfamiliar view of things, and are to greatly change our ideas of the part played by the conducting body. There are indications that we shall be called upon to consider nearly all the activity as residing in the dielectric surrounding the conductors, both in the case of charges and of currents. In this view Faraday has led the way, and we are but extending his ideas. By the dielectric we mean in reality, of course, the ether surrounding the conductor, with its properties somewhat modified by the matter also present. But our attention is to be fixed on the ether.

It is possible to give only the briefest outlines of the theory as detailed by Prof. Lodge. It is impracticable now to give any account of the mechanical analogies which he uses so freely to make his meaning clear. Such a sketch can carry very little of the force which the fuller statement would possess.

To explain electrical charges we are to assume what seems a very artificial and curious condition of things as existing in the ether. It is perhaps the most inconceivable part of the whole scheme, and we are to accept it provisionally as a "working hypothesis." It is that the ether consists of electricity in a state of entanglement similar to that of water in a jelly. The electricity (and the ether for that matter) it will be remembered is incompressible; and when an electromotive force acts upon the electricity it produces no compression but rather a tendency toward displacement resisted by force resulting from its entanglement, just as we know that the water contained in a mass of jelly does not flow out at the bottom or sides, although gravity is

[1] Read before the Chicago Electric Club, June 8, 1891.

constantly urging it downward. This is the condition of things in a dielectric. Conductors are very different in this regard, and are like cavities in the jelly, cavities, however, filled with a more or less porous body which allows the ready passage of a liquid, but with friction.

Some idea of what is involved in charging a body is gained by conceiving that a little of an incompressible liquid is forced into a cavity in a mass of jelly. There will result a strain of the walls of the cavity which will enlarge the space within. When electricity is forced by an electromotive force into a conducting sphere, we can best conceive of what happens by supposing that the dielectric surrounding the sphere is forced back a short distance from the surface, the intervening space being occupied by a volume of electricity equal to that forced into the sphere. We thus have a result in accordance with the well-known fact that "charges reside on the surface," and we see that there has been no change in the quantity of electricity in the metallic sphere, i. e., there is no charge there.

Let us next consider how conduction is to be viewed, that is, how electrical currents are conveyed Here we meet with equally remarkable conceptions which, however, have much to support them, both in mathematical theory and experimental result, particularly in the famous experiments of Hertz.

The familiar and correct idea is that electricity is forced into one end of a wire by some generator, and flows out at the other end into the ground, or to the generator again; we are accustomed to think that the energy is transmitted just as the electricity is. The new theory is that the energy is on the contrary propagated through the dielectric surrounding the wire, while the electricity flows in the conductor. It is the function of the generator to produce a strain in the dielectric surrounding it. This strain is not, however, transmitted equally in all directions, but is largely directed by the wire, which it surrounds and accompanies to an indefinite distance. By taking up a portion of this strain and dissipating it as heat, the wire seems to make this indefinite transmission possible, as otherwise there would be a balancing of forces which would produce equilibrium and put an end to this staticnetic effect.

In the transmission of power by electricity we are to conceive that all the energy received by the motor has come from the generator not through the wire, but through the air, or perhaps better through the ether which surrounds the wire. That portion of the energy which does get in to the wire is the portion which is wasted as heat, and which never reaches the motor. We can get some support for this idea from certain facts proven by Hertz as well as by several others. It was shown that when the currents traversing a wire are made to alternate very rapidly the flow of electricity is confined to the surface, whereas for ordinary currents it is well-known to traverse the whole wire. If the disturbance in the wire comes from without inward rapid alternations of impulse from the dielectric would be likely to cause superficial disturbances in the wire, which would not be the case if the alternations be slow or if the strain be continuous as with a constant current.

Many experiments have been tried to determine if an electrical current does not possess momentum. Surely the ether possesses inertia, and if electricity is the same as ether, or even a component of it, it should show momentum when set in motion. Very familiar facts do show this property. The phenomena of self-induction are best explained in this way. A current requires time to acquire its full power, and the spark seen on breaking a circuit is good evidence that it does not readily stop flowing. However, there are simple mechanical effects which a moving body possessing momentum should show, which have been looked for in vain. Indeed, any of the ordinary mechanical effects of momentum have never been observed. It is evident that a pipe traversed by a rapid stream of water would, when moved, show results of inertia, as well as whenever the water is suddenly started or stopped. Prof. Lodge explains this apparent lack of inertia by saying "that an electric current really consists of two equal flows in contrary directions, so that mechanically they neutralize one another completely, while electrically, —i. e. in the phenomena of self-induction or extra-current—they add their effects. Or it may mean merely that the momentum is too minute to be observed. Or, again, the whole thing—the appearance of inertia in some experiments and the absence of it in others—may have to be explained in some altogether less simple manner, to which we will proceed to lead up," and he later gives an explanation which cannot be reproduced here. All that can be said at present is that there is no experimental evidence that need be taken as disproving the existence of inertia of electricity, while the facts of self-induction are strong evidence in favor of its existence. Furthermore the well known theories of Ampere, Weber and Maxwell concerning magnetism and dia-magnetism require that an electric current shall persist in its motion until checked by some resistance, in other words, shall possess momentum We have good grounds then for asserting that in all probability electricity possesses inertia.

The flow of electricity is surely opposed by friction. Ohm's law may be interpreted as affirming that the friction between the electricity and the conductor varies directly with the velocity of the former.

In this connection it is of great interest to consider the density and the elasticity of the ether. If ether and electricity should be found to be one and the same agent, then the values to be given for the ether become those of electricity.

We have seen the velocity of transmission of a vibration in an elastic medium is equal to $\sqrt{\frac{E}{D}}$. This law applied to the ether becomes the expression for the velocity of light, but light we know now to be a purely electrical phenomenon; in other words the only vibration of which the ether is known to be capable is an electrical one. It has been shown by Maxwell that in the formula $V = \sqrt{\frac{E}{D}}$ we may replace the E by $\frac{I}{K}$, that is, that specific induction capacity is directly related to the elasticity of the ether. We may similarly replace the D by μ; that is, magnetic permeability corresponds to density of the ether. These are important conceptions. Induction is viewed as a shearing stress, which if strongly resisted signifies small inductive capacity in the dielectric, or considering the ether we say it resists the shearing stress in virtue of its high elasticity. This means that specific inductive capacity varies inversely with the elasticity of ether. Similarly great magnetic permeability is interpreted as implying great ether density. The ether contained in iron is viewed as possessing a high density, much higher than that in any other matter.

Basing his reasoning on what is called a "justifiable assumption" Sir Wm. Thomson finds that the energy in a cubic cm. of ether near the sun is 1.886 ergs, the greatest tangential stress per sq. cm. 30.176 dynes, the density 9.36x10-19 and the coefficient of rigidity 842.8. The elasticity of steel is about 109 times this last figure.

The only theory yet proposed to explain magnetism is the well known Amperean hypothesis that magnetic phenomena are due to the circulation of electric currents around the atoms of the magnet, these atoms being necessarily perfect conductors of electricity. Dia-magnetism is singularly explained by Weber's hypothesis. A magnetic field is explained by assuming that each line of force is surrounded by a whirl of ether, of which rotation the line of force is the axis.

Of the four methods of manifestation of electricity previously named (charges, currents, magnetism and radiation), the fourth is the most intricate, and in so far the most difficult of explanation. Yet it is by far the best understood, and indeed it may be said in a *general* way to have been completely explained. This remarkable progress has been accounted for by saying that we have very great and peculiar advantages naturally for the study of this class of phenomena through the possession of a sense, that of sight, which directly observes the vibrations in question.

Maxwell's electro-magnet theory of light is now established, and constitutes an immense advance in electrical theory. It involves logically the inclusion of all optical phenomena in the domain of electrical science. The laws of refraction of light may now with some propriety be classed with Ohm's law. Both may be said also to deal with electrical velocities.

The experiments of Hertz on electric radiation have become so familiar that it is unnecessary to do more than to allude to them as constituting in their results an immense contribution to electrical theory.

Only one point in this subject will be considered. It is very well known that the discharge of a Leyden jar, or a flash of lightning is in reality a multiple discharge, an almost instantaneous alternating current discharge, a fact discovered by Joseph Henry. The frequency of the alternation of current in the discharge of any charged body is expressed as equal to $\frac{1}{2\pi\sqrt{LS}}$ where L is the self-induction, and S the capacity. With an ordinary Leyden jar discharge there are something like 10,000,000 vibrations per second, with a wave length of radiation of say 20 metres.

If we compute the magnitudes involved in the production of waves as short as those of light say .0006 millimeter, we will have a body of atomic dimensions, which indicates that light vibrations are due to electric discharges of atoms.

In his address as vice-president of the section of physics of the American association for the advancement of science in 1884, Prof. Trowbridge made the following remarks in answer to the question "What is electricity?" (the title of his address): "We shall probably never know what electricity is, any more than we shall know what energy is. What we shall be able, probably, to discover, is the relationship between electricity, magnetism, light, heat, gravitation and the attracting force which manifests itself in chemical changes. What we are to have in the future is a treatise which will show the mechanical relation of gravitation, of so-called chemical attracting force, and electrical attracting force. and the manifestations of what we call radiant energy. Out of all the theories of electricity, the two fluid theories, the one fluid or Franklin theory, and the various molecular theories not one remains to-day under the guidance of which we are ready to march onward. All that we can truly say is, we have a healthy distrust of our theories, and an abiding faith in the doctrine of the conservation of energy."

Such a view as to the future of electrical theories seems a discouraging one, yet it should not be so considered. We do not know and perhaps never will know what *matter* is, yet the atomic theory is an expression of scientific truth, and is invaluable as permits a clear conceptions of, and deep insight into a very large number of phenomena. While we may never know the whole truth as to the nature of electricity, what is sought for, and what will very likely soon be formulated, is a theory which will give us as definite conceptions of electricity and electric phenomena as the atomic theory enables us to have of the nature of matter and its properties.

It is not probable that Prof. Trowbridge foresaw in 1884 how rapid the progress in solving these problems was to be. In the seven years since he wrote there has been a very remarkable advancement, until now as Prof. Lodge puts it, "The whole subject is astir with life, and every month seems to bring out some fresh aspect, to develop more clearly some already glimpsed truth."

The Sperry Mining company has just built and shipped to the Chicago, Wilmington & Vermillion Coal company, of Streator, Ill., a 100 horse power generator, to be used for operating pumps, etc. The electric motor and car have already been shipped, and the completed system will be in operation in a few days.

American Institute of Electrical Engineers.

The reading of the paper at the general meeting of the American Institute of Electrical Engineers on "An Alternate Current Potentiometer" by Prof. George S. Moler was followed by this discussion:

GEO. W. BLODGETT: I would like to ask if it makes any difference what kind of a lamp is used, or whether one must use some particular lamp for a particular instrument.

PROF. E. L. NICHOLS: The lamp, I think, is a matter of no consequence, only in order to get the best result the lamp should be more than red hot. You will find the sensitiveness increase as the brightness of the lamp increases, up to a certain point. It is best to have a lamp the voltage of which is about that which is to be measured. Through a wide range of intensities in a lamp the accuracy is not materially diminished. Any constant current voltmeter can be used for reading the voltage on that side of the switch. In order that your result may be correct you should have a constant current voltmeter which gives correct indications.

PROF. THOMSON: If I remember correctly, some tests were undertaken about two years ago to determine how much variation was possible in a lamp; that is, if you should drop or raise the voltage, what would be the smallest increase or decrease of voltage suddenly brought on that would show in a lamp? I think we found it was about 1-10 of a volt. It could be detected by watching the lamp very closely—simply putting in a resistance and slipping it in and out quickly.

MR. WESTON: The arrangement I believe is to have an incandescent lamp simply as an indicator, this lamp to be brought from normal value by a direct current and then to have an alternating current of unknown electromotive force passed through it. I can say that that will work very nicely indeed. We have used that method in endeavoring to arrive at a somewhat difficult problem in connection with an alternating current instrument of great sensibility and portability. I think the method was used about three years ago. The accuracy is greater, the greater the change of course in the electromotive force of current flowing through it. The method is undoubtedly susceptible of very close results indeed.

PROF. NICHOLS: I think that it will be found that there is a limit to the brilliancy of the lamp which you can use in practice, on account of the eye. If you have too bright a light, the eye is not susceptible to small changes. Probably there is a maximum brightness which should be used, in order to give the maximum sensitiveness of the method. Our experiments thus far go only to confirm Mr. Weston's statement that the lamp should be burned at quite a high temperature.

PROF. GEORGE FORBES: I would suggest that there is a very simple way of enormously increasing the sensitiveness of this method. As I understand it, the way in which you use it at present is to look at the lamp while the continuous current is serving it and then switch it over to the alternating current and then judge which is the brighter, moving it rapidly back and forward. It seems to me that that method would be enormously more sensitive if you applied two lamps, and used them in a properly constructed photometer with a switch arrangement, which would enable you to connect either of them with the alternating or continuous current. Thus you would adjust the potential of the continuous current until you got very near equality, but you would find that one of the lamps was always a little brighter than the other, owing to the sensibility of the lamp. You would then slightly alter the distance of the lamps from the photometric screens so that on reversing the current you would get an absolute equality, and then you would be able to arrive at a much closer comparison and it would not matter if there was a very slight difference in the illuminating power of the two lamps with different voltages. I feel perfectly sure that this would increase the sensitiveness of the method about tenfold.

MR. LOCKWOOD: I would like to ask those gentlemen who have made this matter a subject of study, whether the eye doesn't eventually tire in watching the indications of the incandescent lamps. I know the ear tires in performing kindred operations for the telephone. I should imagine the eye would tire a little sooner than the ear, if anything.

MR. WARING: I think that the eye does tire, if you watch an incandescent lamp that is up to its normal candle power. At the Perkins Lamp Factory we occasionally get a lamp with a bad spot in the carbon which comes through the pump room without being noticed. To pick those out we are using at the present time a photographic lens which throws the image of the carbon on a screen right in front of the person who is using the photometer. The light in the photometer is so mild that the person's eye doesn't tire. One can watch it all the time and thus readily discover sligth differences in the carbon, while the person who is hanging the lamp will have his eyes so fatigued with the bright light that he cannot see these black spots at all, and I should think that in any work where a person tried to look at a lamp of normal candle power the eye would soon become fatigued.

MR. BLODGETT: Is it fatigue, or is it a loss of sensitiveness which deprives the eye of the power of distinguishing changes?

MR. WESTON: I presume that Prof. Thomson, who has had considerable experience with photometry in an incandescent lamp factory, must have noticed what others with similar experience have, that with an ordinary photometer the eye doesn't seem to get tired at all. The man seems to get more skillful and does the work better in the latter part of the day than when he began to work. I do not think there is any fatigue of the eye. I think the eye gets even more sensitive to slight changes.

PROF. THOMSON: My own personal opinion about the matter would be that the eye as an instrument is a remarkable efficient one, and not subject to tiring, but it really is perhaps the attention that tires.

The next paper discussed was that on "Considerations

which Should Govern the Selection of a Rapid Transit System" by Frank J. Sprague.

T. D. LOCKWOOD: The institute has good reason, I conceive, to congratulate itself on being the recipient of such a thoughtful and thought-inspiring paper upon such a subject. Although the electric railway, rapid transit in general, and the railway motor is perhaps not human nature's daily food it is certainly no small element in carrying the people of great cities to where they can get their daily food, and in sometimes carrying their daily food to the people; and as such, it is a subject that should have our most careful, and perhaps in some respects, our anxious thoughts. While the paper deals mainly with local questions the answers will be of general interest, and will always be of value in considering the problem of rapid transit in other cities; and this, of course, is becoming the problem throughout the world. The conservatism of which Mr. Sprague spoke has been the lion in the path of every one who has sought to introduce any new agent in the progress of mankind, especially those which are the applications of electricity.

PROF. GEO. FORBES: I know that there is always a general feeling over here that progress in electrical invention is retarded by the conservative spirit in Europe, and that we are slow in taking up things, and that you are very much further ahead than we are in all electrical development. I think there is no one who is more ready to acknowledge that than myself, and frequently after my visits to this country I have been looked upon as a renegade for turning against our English modes of doing business, and for not supporting them, and for saying that you had been doing better in America than we are doing there. England has not in the past taken quite the position with electricity that she did with steam. Electric lighting was retarded in England owing to defective legislation and street railways would be working under different conditions in England from what they are here, if it were possible to permit the overhead wires which we see in Boston and other cities of this country. If they could be permitted in London or other towns, we would not be far behind you in the progress of street railways in England. Now, however, we are coming to a new stage of electrical progress, and that is not of street railways, but of real rapid transit railways, and there, I venture to say, that we are ahead of the United States; that in the development of the South London railway we have made a step of very considerable magnitude—not a step of considerable engineering magnitude, but a step of considerable magnitude in overcoming the inertia of the rest of the world; in leading capitalists, municipal authorities and the public generally to recognize that electric traction on a large scale is an accomplished problem. The development that has already proceeded since the completion of the South London railway in bringing before Parliament the West railway, which Mr. Sprague has alluded to, and the other electric railway down Oxford street and Holborn many miles in length, is an indication that it has been realized by all those interested on the other side that this is an accomplished problem.

The South London railway system is working with absolute perfection at the present moment. At the beginning there were some little troubles, chiefly mechanical. The comfort of traveling on this line is worth speaking about. I have noticed in talking with New York men that their idea is that an underground railway is necessarily objectionable. But on the South London railway the service is perfect, and the temperature is uniform, summer and winter.

My own opinion is certainly in support of the view which Mr. Sprague has indicated that the solution for rapid transit in New York is by de-tunneling and electric traction. It is a mistake to suppose that there is only one system of electric traction which could be utilized, that heavy locomotives pulling the train is the only way by which the problem could be solved. But out of the many ways which may be proposed I feel sure that, from the engineering ability which will be called in to discuss the question and to arrange the plans, the outcome will be satisfactory.

Dr. Wahl's paper on "The Future of the Aluminum Problem from a Chemical Standpoint" was discussed.

PROF. THOMSON: There is a source of heat, it occurred to me during the reading of the paper, which has been neglected and which might probably be turned to account in this direction, and that is the mere concentration of the sun's heat by large mirrors or lenses. The temperature is, of course, almost that of the sun itself and will certainly fuse aluminum and we will get it at simply the cost of the use of the apparatus on a sunny day. I can imagine an enormously large lense or mirror which brings its rays to a focus at the bottom, as it were, of a deep crucible, and the material there subjected to that cheapest heat, the sun, from which all our heat is derived through a series of changes which involve great losses.

PROF. CROCKER: I happened myself to have heard of such a process. I do not know how far it has progressed or whether any results have been attained. There is no doubt about the possibilities of high temperature and there is no doubt about the cheapness. I think myself that there is absolutely no question about the possibility of reducing aluminum by carbon provided you have the temperature. I think the argument that carbon has sufficient chemical affinity to draw oxygen away from the aluminum is fallacious because, in the first place, as Dr. Wahl says, the Cowles process is a proof that sufficient temperature will reduce aluminum, because I do not consider that the action there is electrolytic at all. In the second place, carbon can reduce sodium and potassium, which, if anything, are higher or almost as high in their affinities as aluminum. It is simply a question of temperature or condition. Carbon has a peculiar property of apparently developing high chemical affinity at high temperatures. The higher the temperature the more it develops a tremendous chemical affinity for oxygen. And it seems to go up directly with the temperature. I do not believe it is unlimited, but it will go up sufficiently high, I think, to reduce alumina to a metallic state. If temperature and carbon are all that are needed, the sun and ordinary carbonaceous material will make certainly a very cheap process for reducing that metal. But the production of that temperature by anything but electrical methods or the sun's heat seems to me discouraging. No metallurgical temperatures approach that, nor is there any likelihood of their reaching it. Regenerating furnaces produce very high temperatures, but not high enough for that purpose. It is not impossible. Of course the principle of regenerating furnaces would apparently allow us to reach very high temperatures but I doubt if they would work very well, and I should think very high temperatures would possibly be obtained by electrical heating.

DR. WAHL: In connection with this portion of the discussion I desire to say simply that while I have no doubt that the reaction in the Cowles furnace is to some extent an electrolytic action, yet I am of the opinion that it is probably what I have described it to be and what I believe it is generally accepted to be—a condition of a reduction by the excessive heat which can be produced in the furnace—purely a chemical reaction effected by the enormous heat of the electric arc—the enormous heat rather caused by the passage of the current through this resisting material. But what actually takes places in the Cowles furnace or in the Herault furnace is difficult to see. I would not desire to have myself quoted as making any positive statement. It is probably partly electrolytic and partly chemical. As to the possibility of obtaining a sufficiently high temperature directly, without the aid of electric heating, I think that it is impossible.

DR. LEONARD WALDO: Aluminum is a material of structural engineering and the conditions of its work must conform to those ideas which belong to the shop and seldom belong to the laboratory. Our works were built at the beginning of the aluminum era and we bought freely. We bought many thousands of dollars' worth of metal. Then we began to learn our lessons. We took the books and papers from the laboratories and they said nothing was simpler than to cast aluminum bronze and we proceeded to do that very simple thing of casting aluminum bronze, and we poured more metal down holes than any concern in the United States. We poured it down systematically and got uniform results. We read the books again and they said it was a very easy thing. Here are some of the results [showing some spongy samples]. One of these is a section sawed right out of the inside of a propeller wheel for the United States government. We were going to give them 60,000 pounds to the square inch on a direct pull and we were going to realize a fortune by building all the propeller wheels for the navy. It was poured carefully as the books direct and that was the result. Nobody knew why. One of the head casters thought the metal was poured too hot and another thought it was poured too cold and another said it was not poured right But the work came back and we began to learn about aluminum and we discovered that there is one thing necessary; that is, that the experience of past centuries cannot be safely ignored, because aluminum is a new metal; that if you get silicon and put iron and put all the by-products of a furnace into your silicon you are getting a good result every time. I never knew nature to make any mistake in any of her experiments.

In the present condition of affairs, I do not know that the estimates that we have listened to are of very great value to us, because all of the processes depend on the chlorides, depend also on the cost of acids in this country as compared with their cost in England, and while the estimates are quite correct so far as the cost of steam and that sort of a thing is concerned, the price is still maintained in the United States. But we would not care so much for the price if we had the quality. There is no known material, except steel, of extraordinarily good quality, which will give you the economical values aluminum bronze gives you. Here is the same style of casting, but showing the effect of improper work in the casting of the metal in the blow-holes which come under the risers. This metal is perfectly sound otherwise, but under the risers are these blow holes, which unfit if for the particular work for which this was designed These results are extremely important, because under a proper manipulation of the bronze it is possi le not only to give metal castings which are absolutely non-porous, and which will stand any pressure up to several thousand pounds to the square inch, but it is possible to give them strengths running from 90,000 to 100,000 pounds per square inch in the casting. I have taken pains to come this afternoon because some one from the standpoint of the engineer must put on record a distinct and emphatic protest against the use of an alloy called aluminum. It simply cannot be used to get definitive results and therefore it cannot be used in our practice.

Now to come to the important application of aluminum bronze. Aluminum, as you quite well know, probably has a conductivity equal to copper, bulk for bulk, and it has two and a half or three times the conductivity of copper, weight for weight. I am speaking now of aluminum which is free from silicon and from iron. But here the impurities of silicon and iron come in with a particularly damaging effect. The conductivity of the alloys of aluminum and copper as ordinarily made bear no relation whatever to the proportional bulk of the metals themselves, and until the producers of aluminum bring the aluminum product over 98, 99 or 99.9 —the nearer they can come to it—the electrical engineers have got to be content with quite a low order of conductivity, both in all sorts of places where metal is applied and in their wires where they want strength, and expect to get the conductivity, but fail.

THE CHAIRMAN: In regard to the conductivity of an alloy, I should doubt very much if the average conductivity of its constituents, or any approximation to it, could be expected. For example, pure silver put into copper will very seriously interfere with the conductivity, and pure silver is supposed to be better than copper in conductivity. That seems to be a fatal fact about the conductivity of alloys, that any alloying seems to reduce conductivity very seriously, and the smallest percentage of alloy or impurity —whatever you might call it—has a very great effect upon a reduction in conductivity; and this seems to be true, no matter what metals are put together.

DR. WALDO: Of course, in discussing all these alloys, the best conception to have is that the alloy is a glass rod transparent to electricity. The oxides and other things which come in and which are precipitated and act as chemical stains stop the flow of the current, and whether or not the pure aluminum and the pure copper obey that law of disproportionate conductivity, is a question which I think no man can pronounce on, because I do not think any man has ever tried it. A great many people have mixed the aluminum and copper and determined the conductivity of the result, but that is a very different thing.

THE CHAIRMAN: If it is a fact that aluminum bronze or alloys of aluminum and copper or other metals can be made having a conductivity approximating the mean of their constituents, it would certainly be a valuable thing in electrical engineering, a thing greatly to be hoped for.

MR. WESTON: I have used aluminum quite extensively and I think Dr. Waldo is mistaken about its conductivity. I have found it to be 60 per cent. that of copper. Of course, I think what Dr. Waldo says about the action of small quantities of silicon or iron in aluminum when mixed with copper to form an alloy may have a very marked influence upon the conductivity and working of the alloy. Silicon has a very marked influence on the working qualities of steel, and I think also on the conductivity.

DR. WALDO: I would like to say that my own best determination of the conductivity of the best aluminum I could get was .6604, but I never have seen a piece of aluminum which was higher than .9903. I have had a number of samples submitted to me which by perfectly easy analysis have run as high as .9975 and .9908. But a rigorous analysis has always reduced the amount of the purity of the aluminum. I doubt extremely whether any ordinary samples of aluminum which you would handle would run to .99. My personal judgment is that the conductivity might run very close to that of copper itself, and there has been no evidence on record that I know of which would tend to disprove that, while a good deal of the work in our laboratory would go t show it.

The discussion on "Electric Meters" follows:

PROF. THOMSON: One form of meter which I have designed is mentioned. As Prof. Forbes remarked, it ought not to be called a watt meter. It is called a recording watt meter; it records the rate and integrates the rate for the time. In that sense, of course, it would be proper to call it a regulating watt meter, recording the rate and multiplying it by the time. This meter was designed for a certain purpose, to fit certain conditions. One of those conditions was to give the customer an opportunity to read for himself just as he does with the gas meter record and to understand it. That we found in a good many cases an important matter, and our efforts were spent largely to secure that end, to get, as it were, an instrument that would represent the gas meter, recording on a dial the use of current. It will not readily respond to one volt or to ten volts, perhaps, but it will respond to conditions of considerable variation in the volt, as well as enormous variation in the current. There are features about the meter which did not appear in any former arrangements, and these features I think are features which have made it a success. The new feature of the meter before us is the recording by a photographing method as distinguished from recording by other methods. I remember distinctly making a meter in 1886 or 1887 which was substantially in principle the same, only the record was made on a sheet of paper by punching little pin holes at intervals. The friction was as little as it is here, and the little point that passed over the paper was clear of the paper until an electro magnet struck it a blow and made a little indentation, the point jumping up again and being ready to take a different position. That eliminated the element of friction, and I had in that meter an arrangement for doing away with clock work which worked very satisfactorily. It is nothing more or less than a pendulum which is self starting. There was an electro magnet which pulled upon an armature and a self-starting pendulum. This depending lever of the pendulum was pivoted, working a pawl, which furnished the motion for winding the paper. The pendulum at rest was always stopped in a position ready to start, and it broke its own circuit, worked the set of contacts, and the magnet kept the pendulum in motion, so that our rate was perfectly regular. The little point was mounted on a spring connected with the ammeter, which was merely a little piece of iron on a vertical shaft inside a coil This little point was over the strip of paper, and the electro magnet hammer at every revolution of this ratchet wheel which, constituted practically the whole of the clock work, struck a blow on the paper, giving a mark. The paper as it came off would be a series of dots, and then they would change according to the load, and the same process of integrating this curve would be used as in the meter before us. For this purpose we did not waste any energy as here used in working an incandescent lamp for the meter. No doubt the lamp could be diminished in size. But if it should give out from any cause it is not replacable at once, unless some one discovers the difficulty; and then the record fails. I do not care to go into any further criticism in relation to this matter; but I think when we look at those things we should be prepared to look at them from all sides.

MR. WALKER: The remarks of Prof. Thomson are very explicit and undoubtedly true. We do not claim for that meter that it is a new principle beyond the question of the securing of the results of the action of the ammeter needle. I am also aware that devices such as he has explained in which a slip of paper has been marked by the pulsation of the ammeter needle have been tried very frequently as well as the siphon pen. However, the major criticism that has been made on that meter is a very good one, and that is the possibility of the breaking of the lamp. But while in this case you see a lamp burning very brightly, the candle power used there is not at all necessary. If the possibility of breaking the lamp should prove to be a serious objection, however, it is very readily overcome by putting in a double filament, or a contrivance for two small lamps.

The mechanism there and the power required to operate the same depend entirely upon the size of the wire with which the magnet is wound, and as I said before, the candle power of the lamp is slight consequence, inasmuch as the burning of a match would be ample to give us all the record necessary. In other words, we do not claim anything new for it, except the combination of photography, which apparently has never been used before.

C. REGINALD VAN TRUMP: The distinguishing feature of this instrument is that it is a recording ampere meter, and I should like to ask Mr. Walker what he has to offer us in the way of a recording voltmeter. The use of such an instrument would immediately suggest itself to those who have to do with central station management. Such an instrument placed on lines in a station and a duplicate instrument located at different points on the mains would give us cards which would give valuable data in the distribution of our copper on the mains. And besides that a recording ampere meter to automatically register the load on a central station is a very nice feature. It does away with the unreliability of having an attendant mark upon a chart the load on the station at different times; so that we can at any time tell exactly what we have done and what our proportion of fuel to output has been.

MR. WALKER: I would state the principal object in the meter, the primary object in the meter, was the contemplation of the very need that he spoke of then. We would devise an instrument sufficiently large to record the amount of current produced at the station, and the smaller sizes for distribution service. A recording voltmeter operating on precisely the same plan is now nearly ready.

E. T. BIRDSALL: The subject of recording meters at stations has, I think, come to every station manager, and they have all felt the need of them; yet in a great many of the stations they make a curve of the load every day by hand.

The great trouble with these devices is friction. The use of a pen or pencil is not feasible; and after talking with a good many station managers I gave up the idea that is used in this meter—that of photographing. The station managers or the superintendent would not bother to develop the slip. They want something that is in pencil, like steam engine indicators, that would not require further attention.

MR. WESTON: Unless current is passing through the main coil circuit in a Thomson watt meter it seems impossible that any action of the retarding mechanism would take place on the armature to produce motion of the armature simply by the shunt coil, and if such a thing did arise I should attribute it to something totally different and not to the permanent magnets in that instrument. It would indicate that the insulation of that circuit in which that armature was placed should be examined. The form of meter having the dial seems to me to have a great many very marked advantages over any other type of meter known. In the first place the public is more or less acquainted with the gas meter. One can make note of the changes on the dial and have a check upon the gas company, assuming, of course, that the meter is moderately correct. On the other hand a system of metering which does not enable the consumer to check the results, to check the consumption, seems to me to be open at least to some objection and possibly considerable objection and suspicion on the part of the consumer. Hence you can readily understand why so much time has been spent in endeavoring to bring that type of meter closely approaching the gas meter—to the state of perfection to which it has been brought to-day. The public is suspicious on this question of meters anyhow. They unjustly, I think, blame meters for things which do not exist, or only exist in their own imagination. In the gas business that is exactly the same. The gas meter is not an instrument of absolute precision, but it is a good practical instrument. Any one who has investigated it will admit that it is a very reliable thing indeed, if kept in repair. It does not need very much time to keep it in repair, or very much attention. And if electric meters could be brought to about the same state of efficiency that gas meters are, and I think they have already reached that state, and even excelled that, it is sufficient for the requirements of the art.

It is generally believed that in recording voltmeters friction would be the principal loss of power. Now that is not so. I think you can get the recording voltmeter with recording measurement so perfect and so simple in character that you can practically eliminate friction from that part of the apparatus. The temperature changes are very frequently overlooked and they frequently amount to a very large sum indeed. They can be compensated to a certain extent. But there is a good deal of misconception about that question of compensation of instruments. A short time ago I devised a little apparatus for compensating for change in temperature, which consisted substantially of a little thermometer, the bulb of which extended over upon the coil of the instrument so as to indicate the temperature of the coil. The thermometer bulb is supposed to be small, and the instrument as actually made was not as small as it should be and it responded very readily to slight changes in the temperature of the coil. You could read the thermometer from the outside of the instrument and to avoid any computations I put on a little device by which you could turn an index around to a point corresponding to the temperature indicated on a thermometer, that is to say if the thermometer showed 75 degrees, then you would turn the indicator around to a point indicating 75, and you compensated without any calculation whatever. I was somewhat surprised, however, by the publication of the thing. It got into the journals before I was ready to have it published, and I saw an article in one of the English journals, I think it was the *Electrician*, saying that such a thing as that was of no use; it was easy to compensate an instrument without any such device. Now the writer of that article had not given as much thought to it as he ought to have done If he had he would not have expressed such things as he did in the article. I did not take any notice of it. Well, it overlooked one important thing that you might compensate for air changes quite readily, and yet not compensate for changes produced by the heating effect. Now to get an instrument properly compensated you must compensate for both things—changes in the instrument itself due to changes in the atmosphere, and changes in the armature by the actual passage of the current. When you have a device that will accomplish that, then of course you do not need any mechanical device to switch into a certain fixed point. It just happened that at that time I did not have a device of a character which I could put in a satisfactory form. I think now I can do it. It frequently happens that criticisms and remarks are made about the operation of apparatus which prove wholly unjustified and untenable upon a close study and examination of the things themselves.

PROF. THOMSON: I think Mr. Weston has shown by his remarks that he has spent a good deal of thought on this very problem, and understands the conditions most fully. It is not an easy thing, and I can say it after considerable experience, to get final results corresponding to those we may get at the first. You may make a laboratory apparatus and produce it as perfectly as possible and put it out into commercial use and you will find difficulties. I have frequently had that experience, and that experience has come to me more forcibly, perhaps, on the meter question than on any other. It is not until you have had commercial experience that you can make those little refinements which are shown to be absolutely necessary. There is just one point I wish to make before closing my remarks, and that is that it is not a case of getting a practical meter, but it is the case of making a thing that can be put on the market without costing too much. You may have a very fine mechanism; you may have an excellent device for the purpose, but if it costs $50 nobody will take it.

MR. WESTON: Prof. Thomson made some remarks about the cost. I think he is wrong. I should take issue with him on that. I think the best thing electrical engineers can do in this state of the business is to produce the very best thing that they know how. It is true that one company starts and puts a meter on the market at say $20 or $18. That meter may be very good, or it may not be very good, but I think that it is not very good; that the man who follows along and tries to get up a meter should make a very much better meter, and get a price proportionate to the superiority of the instrument. I think that question of low cost plants and apparatus in electric lighting means in the end very high cost. Cheap engines, cheap boilers, cheap wiring—everything cheap means in the end everything very dear. Now, you see what the effect of it is. All through this country stations are being remodeled to get in the very best of appliances—triple expansion engines—the maximum economy in every direction consistent with good work, and the meter, I think, should be given just as much consideration as the rest of the plant. Do not make the cost so that you cannot make the meter really fine and good. I would increase the cost of the meter and put better work in it and make the best work I could.

PROF. THOMSON: I would say that I agree most fully with Mr. Weston in regard to this matter. Those are the sentiments which I have worked upon, but when I make that argument at the Boston office of our company, the answer is, yes, and so and so sells a meter for so and so, and by the way his has a dial on it, and we must do something about as well, even if we sacrifice something in the meter. I hold just as Mr. Weston does, that you cannot do the thing too well. It is a nice problem, anyhow. It is a delicate affair, and you can not get it too good. You must look to cheapening afterward. But that is an argument which the business managers fail to see.

There is one other point. I would say here that, of course, in an electric meter we measure electricity, or at least we measure the volts and the amperes. In the gas meter it is different. We measure whatever comes through, whether it is air or gas But we cannot adulterate our electricity.

The discussion of Milton E. Thompson's paper on "A Study of an Open Coil Arc Dynamo" brought out many interesting points.

PROF. ELIHU THOMSON: I called Mr. Thompson's attention to the blowing out of the spark as expressing an erroneous idea in relation to the machine. The air blast in the Thomson-Houston three coil machine was introduced for no other purpose than to make it possible to run the machine steadily at high differences of potential with a commutator which could be freely oiled. It was found in the early experience with the machine that it was possible to construct a machine up to about twelve or fifteen arc lamps which would retain the normal working condition without flashing over, as it is called—short circuiting across the slots and the short circuit being carried around. But beyond that potential difference there was imminent danger, although a twenty-five light machine might run for an hour or an hour and a half without any flashing over or short circuiting. Of course the tendency to flash over increased with the difference in potential. Now it was also desirable to run the commutator with a film of oil, but when the commutator was freely oiled the limited potential which could exist without flashing was much lower. Even a ten light machine might flash readily if there was a good deal of oil on the commutator. In the early days men would oil the commutator. It was almost impossible to keep them from squirting oil from a can on the commutator. The Brush machines were also very sensitive to this action, and the company's recommendations were very distinct on the point of oiling the commutator—that is, to take a rag and grease it with a little vaseline and touch the commutator lightly. If the commutator was thoroughly oiled there would at once be a flash.

Another thing, the oil on the commutator of course diminished the wear, so that if there was any little roughening it was relieved a great deal from cutting and making copper dust around the commutator. I tried in the early days to get rid of the difficulty and did get rid of it by using condensers on the machine. I took the three coils and led the connections from each segment to a triple condenser. That preceded the development of the air blast. There were three foils in inductive relation. On a machine up to six or eight lights I found I could actually obliterate the sparking at the tips of the brushes and the brushes could be moved quite a distance without causing sparks while the machine was carrying its load. But I also found that the condenser was subject to perforation. There were conditions arising which raised the potential enormously, and I could under certain conditions get static charges. This is a very interesting matter indeed as looked at from the present standpoint in relation to alternating charges. From a single turn of the wire leading from the segment to the condenser foil I could get discharges of an eighth of an inch from one to the other; a discharge which refused to run around the coil—in fact, through the double insulation of wire and the air space between, the discharge would snap across this point, and if it did not get a chance to do that it was very apt to go through the condenser foils. I tried to apply that principle to a much larger machine and I found I could not make the condenser live under these conditions. It would perforate, although it was a remedy for the flashing. The tips of the brushes were practically quiet. It did not fulfill the conditions in practice, so that it led to the trial of an air blast on the tips of the brushes, and the reasoning used in getting the air blast was that on the leaving of this segment there would be a small amount of current still fed from the segment to the brush, which would, as it were, tail off, and the sparks would be thicker at the brush and gradually thin out to a fine point and then stop. Then the segment would change polarity and go on to the other side. But naturally, if the change of polarity was immediate on the cessation of that spark, there might remain, as it were, from the spark, hot gas, which would enable the discharge to take place in the opposite direction, and that was a flash which would be carried over from the arc. My idea was simply to blow a cold blast of air and thereby drive that spark away and insert, no matter how thin, a layer of cold air before the reversal was accomplished and in that way to keep the insulation of the machine. That process is found effective even with a three coil commutator up to 3,500 or 4,000 volts with the pressure, of course, slightly increased as we rise.

E. W. RICE, JR.: In connection with the remark Prof. Thomson made that the flashing of the commutator was due to the reestablishment of the arc across the segment by the hot gases, I think it would be interesting to state a fact which I believe is not generally known, but which we discovered at the Thomson-Houston factory while experimenting with large lights for government use. In these investigations currents from 50 to 100 amperes were used, the potential difference being fifty volts, taken from a machine that would produce about seventy-five volts. We found we could turn out the light and allow the arc to be completely extinguished for a full second; then switch on the current and the arc would be reestablished. This was done repeatedly, showing that the hot gas was sufficiently conductive to reestablish the arc where there was a difference of potential of not more than seventy-five volts.

PROF. THOMSON: I have seen that repeatedly where you could turn the switch and throw the current on again and the arc would reestablish itself, a complete dead space existing between the carbons for some interval. I would say in this connection calling attention to the paper of Dr. Nichols, that we have an observation which goes along with this paper very nicely, that here we have the case of the stoppage and reestablishment and the experiments mentioned prove that the alternations might have been very slow indeed, and with a considerable interval of interruption.

New Electrical Works at Detroit.

The Detroit Electrical Works have closed a real estate deal which gives them sixteen acres of ground between Twelfth street and Wabash avenue, with a frontage of 453 feet on the Grand Trunk railroad. On this tract of land the company contemplates putting up one of the most extensive electrical manufacturing establishments in the country. The new works will include a machine shop, foundries, pattern shops, finishing shops, steam forges, erecting shops, carpenter shops and laboratories, and possibly a large power plant capable of furnishing current for the motors of the whole manufacturing establishment. The present works will be continued in operation for the manufacture of various kinds of electrical supplies and machinery. All the shops will be fitted up with overhead electrical traveling cranes. The intention for the next year's work is to turn out at least five complete steel car electrical equipments per day and one complete generator of a capacity of not less than 100 horse power. The cost of the buildings as now contemplated will be from $200,000 to $300,000 including the amount of machinery that will be necessary over and above what can be transferred from the old works at the Woodward avenue railroad crossing. The plans and specifications are not yet complete, but they are expected to be finished so that the work may be commenced in July, and the works ready for operation January 1st.

Extending down the middle of the property will be two railroad tracks connected at suitable points by cross-over switches. An overhead trolley system will be erected throughout the grounds, and electrical locomotives will be used for all shifting work.

An English mining company operating in El Dorado county, California, has bonded the old St. Lawrence mine, which will hereafter be operated by electricity in conjunction with the Dalmatia and Gopher-Boulder properties. This will give the company a circuit of nine miles, and effect a great saving in the cost of operation. The St. Lawrence mine belongs to Meirson & Alderson, Placerville, and has been worked to a depth of 950 feet. It has, for years been deemed one of the best mining properties in the county.

Electric Railway Men Photographed.

While the representatives of the electrical and other companies that put in bids for furnishing the equipment of the new electric railway in Memphis were waiting for the decision they all had their pictures taken in a group. The eighteen members of the party comprised some of the best known men in the business, as will be seen by the list of names: J. A. Hanna, John G. Brill company, Philadelphia; T. E. Mooney, Bradford Belting company, Cincinnati; J. S. Pugh, Baltimore Car Wheel company; J. A. Correy, John A. Roebling's Sons company, Trenton, N. J.; E. Lang, Louisville & Nashville Railroad company; W. S. Love, Pond Engine company, St. Louis; Guido Pantaleonia, Westinghouse Electric & Manufacturing company, St. Louis; C. Daigh, St. Paul Electric Supply & Construction company, St. Paul, Minn.; J. A. Vail, Hamilton Corliss Engine company Hamilton, O ; H. J. Crowley, Thomson-Houston Electric company (Southern district), Atlanta, Ga.; Wm. J. Clark, Thomson-Houston Electric company, Boston, Mass.; E. W. Tucker, Allis Engine company, Milwaukee, Wis.; W. L. B. Allen, Short Electric company, Cleveland, O.; D. W. Pugh, John Stephenson Car company, Brooklyn, N. Y.; F. X. Cicott, Electric Merchandise company, Chicago; C. B. Osgood, Westinghouse Electric & Manufacturing company, Chicago; F. A. Rogers, Short Electric company, Cleveland; D. B. Dean, Electric Merchandise company, Chicago.

CORRESPONDENCE.

New York Notes.

NEW YORK, June 8.—The question of ventilating the Fourth avenue tunnel of the New York Central & Hudson River railroad has been revived by the state board of railroad commissioners, which has been in session in this city during the last week. Several plans were submitted, many of which provided for the introduction of fan motors for clearing the tunnel of smoke.

Dr. Graham Scott, president of the Scott Electrical Manufacturing company, said that by means of the Huntington search light, which is virtually an arc light, the tunnel could be illuminated so that the light wouldn't interfere with the engineers. The search light, he said, could penetrate all sorts of fog and smoke and steam.

W. J. Hammer advised the introduction of incandescent lights arranged near the bottom of the tunnel after the manner of the system employed in the Hoosac tunnel. He felt confident that satisfactory results would thus be attained. Charles B. Husted read the details of his plan advocating a shower bath. "Fog, dust and smoke," said Mr. Husted, "appear to be the evils to be overcome. We all know that however dense a fog, a light shower obliterates it at once. I propose a shower, to be turned on or off at pleasure and in the following manner: I would place under the roof of the tunnel, in sections of a block or more, iron pipes of sufficient capacity, each connected with the Croton main. At intervals of twelve to fifteen inches I would connect the pipe with small, lateral, perforated pipes, closed at the ends; and valves placed to connect the Croton mains with the tunnel mains could be worked from a central station to turn on a shower whenever the conditions required it. Simple as this plan is, I am satisfied it will kill any fog, lay the dust, and clear the atmosphere."

L. J. Wing proposed a system of rotary fans and three towers. The first thing necessary to the success of his project would be the building of a well in the center of the double tunnel. Then each track would have a tunnel of its own When every opening in the tunnels had been closed, Mr. Wing's rotary fans would get to work, and in four minutes drive the foul air up through the three towers, which ought to be higher than the adjoining buildings, so that the neighbors wouldn't be plentifully supplied with smoke and steam, and other disagreeable things.

Nat Sawyer, one of the Central engineers and head of the local lodge of the Brotherhood, told the commissioners that the engineers wished to protest vigorously against the use of any light in the tunnel. Mr. Sawyer said if the tunnel was lighted the engineers couldn't see the signals. Another Central engineer, Charles Hall, supported Sawyer's position in regard to the danger in lighting the tunnel.

H. Charles Ulman advised exhaust fans near the roof of the tunnel for ventilation, and electric lights set into the roof for illumination.

Ever since the Rapid Transit commission made its report there has been a lively discussion in the daily papers over the proposed plan. The *World* and *Times* have earnestly supported the commissioners' position, while the *Sun*, ever favorable to Jay Gould, opposes the subway scheme. The policy advocated by the *Sun* is indicated in the following abstract from Wednesday morning's leader: "Take the lines of the present elevated railroads; connect them with each other as experience and convenience may indicate; remove their supports from the places they now occupy and disfigure in the central parts of the streets, and plant them upon the curbstones or close to the curbstones; erect structures of steel; three stories high, the first story being used only for the pillars, and the second and third for railway tracks; put the tracks for way trains in the second story and the tracks for through trains in the third; have stairways convenient for passengers to move freely between way trains and express trains; have elevators to carry the passengers up from the ground and back to it; and then we shall possess a system of rapid transit railways that will be safe, agreeable, comparatively inexpensive, and altogether satisfactory. And besides, it will be purely American, and everybody will like it."

The article closes with the following characteristic recommendation: "We earnestly commend these suggestions to the consideration of the Rapid Transit commission, and still more earnestly to the consideration of all that portion of the public who are not crazy and not fools."

The Chamber of Commerce read the report of its committee on the rapid transit problem last Thursday, in which it approved the suggestion of the Rapid Transit commission that an underground system operated by electricity be constructed. It was also agreed that the elevated system should be extended. The report says: It should be remembered, howewever, that this is comparatively an untried means of transit, the Greatbead system in London not having as yet been sufficiently developed to give assurance that it is adapted for long distances and high speed; that the capital is not yet assured to build such a road, and that there are many people who prefer the better light and ventilation of the elevated roads with somewhat slower speed than is contemplated by the tunnel system.

Harris A. Smiler, James J. Slocum and Joseph A. Wood, all under conviction for murder, but who had appealed to the federal courts, were resentenced by Judge Barrett in the Supreme court term Wednesday to be executed at Sing Sing prison during the week beginning July 6th next.

In the case of the "Jap," who is also under sentence at Sing Sing, Roger M. Sherman has moved for a reargument. This case has been in all the courts, including the United States Supreme Court, and the judgment has been affirmed in them all. The motion for reargument was on the ground that the defendant's counsel in the court below, John M. Heizleman, was never permitted to practice in the courts of the United States, and that he had no license. The court took the papers.

Edwards H. Goff, formerly well known in electric lighting circles in this city, died on May 28th at the age of forty seven years. For some time Mr. Goff was the president of the American Electric & Manufacturing company.

The arguments in the infringement suit of the Edison Electric Light company against the United States Electric Lighting company were concluded before Judge Wallace in the United States Circuit Court yesterday afternoon. Judge Wallace said that he would announce his decision as soon as possible. He intimated that it was doubtful if he would announce it by July 1st, after which time an appeal would go to the Circuit Court of Appeals about to be organized. In the event of a decision before July 1st an appeal would be heard in the United States Supreme Court. The models and exhibits will be sent to Syracuse, N. Y., where Judge Wallace will examine them. J. L. B.

San Francisco, Cal.

SAN FRANCISCO, June 4.—The cities of Portland, East Portland and Albina, Ore., which, at an election held on Monday last, were consolidated into one municipality of 80,000 people, have 72¼ miles of street and suburban railway. Four systems of traction are in use, there being 20 miles of horse car lines, 5¼ miles of cable railway, 18 miles of steam motor and 29 miles of electric overhead road.

The Pacific rolling mills of San Francisco are building up quite a business in the electric railway line, the latest contract secured being that of furnishing all rolling stock and iron material for the equipment of the proposed line of the Metropolitan Railway company from Turk, Mason and Market streets along Eddy and other streets to Golden Gate park, and thence to the Seaside house, a total distance of about eight miles. Thirty years ago this resort, which was known as the Ocean house, was the most popular about San Francisco, but it has been virtually abandoned for fifteen years. It has now been entirely remodeled, the grounds have been beautified, and it is the intention of the Metropolitan railway people, who own it, to make the place one of the fashionable club house attractions of the city. The vice-president of the company states that the first iron work on the road will be delivered next Monday.

For some months the Edison Electrical company of Oakland, Cal., has been endeavoring to secure an electric lighting and power franchise in that city, but, failing in this, it has purchased the entire plant, franchises and rights of the Oakland Electric Light & Power company.

Henry W. Chase has secured a franchise for an electric lighting plant at Sanger, Cal.

Another new electric road is projected for Oakland, and a franchise for the same has been granted to Edward Pollitz and associates. The new line will begin at Twelfth and Broadway, running thence along Twelfth street to West Oakland, and branching on Sixteenth street to the Southern Pacific depot in one direction and to the railroad yards in the other.

The travel on the Oakland and Berkeley electric line is so heavy that it has been deemed advisable to change the motive equipment of the big combination coaches from 30 horse power to 50 horse power each The speed in the suburbs will be increased from 12 to 20 miles per hour, and it is believed that these alterations will be effected by September. Eight new cars have also been ordered. Frequently 150 passengers crowd upon a single car, and the 30 horse power motors are scarcely sufficient to pull such a load around the short curves.

During the last fortnight the city solons have been looking into the overhead wire system and its alleged hazards, and as a result considerable interest has been aroused in the public mind as to the advisability of permitting overhead circuits in the business portions of the city. Pursuant to an invitation of the mayor a number of persons interested in electrical matters assembled in the mayor's office to discuss the situation, but the meeting narrowed down into a controversy principally between the Thomson-Houston representatives on one side, and Prof. N. S. Keith and the Pacific Electrical Storage company on the other. The Thomson-Houston people claimed the overhead system to be the only successful electric traction system, while the Storage company, which is the Pacific Coast licensee of the Accumulator company, contended that the storage system is an entire success, citing the road in Beverly and Danvers, Mass., the Eckington road in Washington City and the Dubuque, Ia , road as instances. It is reported that during the first session an advocate of the overhead system stated that the shock from a 500 volt circuit was entirely harmless, that it had been frequently taken accidentally, and sometimes for fun by electric railway employes, and that if necessary a man could be produced who would grasp the terminals of a 500 volt railway generator. From a desire to refute these statements the opponents of the overhead system proposed a multiple series of 80 lamps, inserted in an arc circuit and so arranged that any potential from 50 to 500 volts could be taken from terminals. The overhead people were invited to "Step up, gentlemen," and with the invitation came the observation that the city physician was present, and that the coroner could be quickly summoned. But the other side respectfully declined, and in denying the assertions attributed to it regarding the entire harmlessness of a 500 volt circuit, alluded to the exhibition as a "theatrical" effect, more or less misleading. "There is no fun," they said "in taking it. It is not pleasant to be struck on the head with a club, yet it will not necessarily kill. It is claimed though," they continued, "that no human being has yet been killed from a 500 volt current."

No conclusion in the matter has yet been reached, and in the meanwhile the San Francisco and San Mateo Railway people are working nights, days, Sundays and holidays in their endeavor to finish their road and overhead wiring before final action on their temporary permit is taken by the Board of Supervisors. For a time the company was paying competent linemen $1.00 per hour. S.

Cincinnati, O.

CINCINNATI, O., June 6.—The Cincinnati Electric Power company, recently organized here for the purpose of furnishing current for motors, has commenced work on its plant, which is located on Produce street near Second. The location at the point named will open up a new section of the city which has heretofore been out of reach of the various electric companies, thereby giving the new company a new field in which to work. It will start out equipped with one 150 horse-power Babcock & Wilcox boiler, one 150 horse power Houston, Stanwood & Gamble engine, Laidlaw & Dun pumps, Hoppes heater and two 75 horse-power 220 volt Davis generators. The station is large and commodious and is being laid out with a view to numerous additions. G.

Pittsburg, Pa.

PITTSBURG, Pa., June 6.—The Pittsburg Electric club is now successfully launched on the road to prosperity. It has already about 150 active members, and the executive officers of the organization are now seriously considering plans for the renting of a building to be occupied by the

club. Several locations are already under consideration, and it is expected that a decision will soon be made.

The club proposes to have an establishment for its members replete with all the requirements for sociability. There will be a lecture room, a reading room, possibly a restaurant and such other accommodations as may be demanded, especially by the younger members of the fraternity.

O. B. Shallenberger, the electrician of the Westinghouse Electric & Manufacturing company, has gone to Colorado for his health. Mr. Shallenberger has not been well during the winter, but it is expected that he will return completely restored to his former health and vigor.

The meeting of the Westinghouse stockholders called for last Monday was again adjourned until June 23d.

E. H H.

Louisville, Ky.

LOUISVILLE, Ky., June 6.—The Consolidated Street Railway company is getting along well with the lines that are to be equipped for electricity. The Fourth street line beyond C street has been opened. Walnut street has been equipped with wires from Fourth to the intersection of the Green street line at Fifteenth street. The Shelby and Market street lines, owing to unexpected interruptions, will not be put in operation before next week. The Second street line will begin running about July 1st.

Quite a sensation was created in business circles here when H. H. Little, general manager of the Consolidated Street Railway company, tendered his resignation to the Board of Directors. The company positively refused to accept his resignation, but Mr. Little was firm and no amount of persuasion could induce him to reconsider his action. It was then decided to grant him a leave of absence for two years if he would agree to withdraw his resignation, which he did. Mr. Little goes to Buffalo, N. Y , where he has accepted the position of general manager of the Cross Town railroad at a salary of $12,000 a year. He has been at the head of the street railway system in this city for many years, and it is with the greatest regret that the Board of Directors sees him depart. He will leave June 1st.

The Louisville Warehouse company has just placed it its new building a 20 horse power electric motor. In will operate four elevators.

The electric car line to Jacob Park is now assured. The cars will run out Fourth avenue to P street, thence west through the Jockey club grounds to Wilder Park. They will then go out Taylor boulevard to the park, where the company has purchased an acre of ground on which to build a station. The material has been ordered. The line will be in running order before August 1. Ten or fifteen cars will be operated and the fare will be ten cents. The line would have been built some time ago but for the fact that the street car company was unable to secure the right of way. This obstacle was finally overcome this morning, and the work will be begun immediately.

The new electric car line on Market street is soon to be put in operation. The overhead wires have been strung and everything is in readiness for the cars to start. It is expected the line will be opened in about three weeks.

C. C. Y.

PERSONAL.

Geo. H. Bliss has been in St. Paul and Minneapolis for several days combining business and pleasure.

T. D. Lockwood of Boston attended the meeting of the Chicago Electric club last Monday evening.

J. M. Lennon, general manager of the Standard Electrical corporation of Minneapolis, Minn., was in Chicago last week,

William Bowen, formerly connected with the Hawkeye Electric company at Davenport, Ia., is now representing the Thomson-Houston company at Oskaloosa, Ia.

C. H. Holmes and Allan Showman, representing a St. Louis syndicate, were in Racine several days last week negotiating for the purchase of the Belle City Street railway.

Cards are out announcing the marriage of Arthur F. Stanley to Mildred Beckwith Knapp at Netherwood, N. J., June 10th. Mr. Stanley is a member of the firm of Stanley & Hall.

C. K. Mead, general manager of the new Electric Light & Power company, Des Moines, Iowa, was in the city one day last week purchasing a new generator and other machinery and material for an extension of his plant.

E. V. Cavell has retired from the editorship of the *Street Railway Gazette*, Chicago, to accept a position as general manager of the street railway department of the *Electrical Age*. Mr. Cavell has been identified with the *Street Railway Gazette* for several years, and has a large acquaintance. He will make New York his headquarters.

S. A. Barton, president of the Brush Electric company, Cleveland, was in Chicago last week. He visited the Chicago Electric club on Saturday, and was greatly pleased with the arrangements that have been made. He congratulated the management on the prosperous appearance of the organization. Mr. Barton was formerly president of the club, and proved a most efficient executive officer.

NEW INCORPORATIONS.

Battle Creek Electric Railway company, Battle Creek, Mich.; capital stock $100,000; electric street railway.

Gulf Electropoise & Thermo Electric Battery company, New Orleans, La.; capital stock, $25,000; to deal in electrical instruments.

Davenport Electric Railway, Light & Power company, Davenport, Ia.; capital stock $300,000; street railways, electric power, light, etc.

United States Electric company, Chicago; capital stock, $10,000,000; for the manufacture of electrical machines, instruments and appliances.

Arapahoe Electric company, Denver, Colo ; capital; stock $500 000; to furnish electricity for light, heat and power in the city of Denver and suburbs.

Kent Electric Writing Machine company, St. Paul Park, Washington county, Minn.; capital stock $500,000; manufacturing the Kent electric writing machine.

Ashtabula Rapid Transit company, Ashtabula, O.; capital stock $150,000; constructing, operating and maintaining a street railway and electric light and power plant.

Covington Machine company, Covington, Va.; capital stock, $200,000; steam engines, machinery, railroad cars, foundry, gas and electric works, mercantile business, etc.

Elwood Electric Light & Power company, Elwood, Madison county, Ind.; capital stock, $10,000; to furnish electric lights for the city of Elwood, Madison county, Ind.

Bellwood Electric Light company, Bellwood, Blair Co., Pa.; capital stock, $20,000; manufacturing electricity and supplying the same through appropriate conductors and contrivances to the public.

Citizens' Electric Lighting & Power company, St. Louis, Mo.; capital stock $750,000; to construct and operate electric light plants with wires and lines for transmission of electricity for light and power.

Chillicothe Water, Electric Light & Power company, Chillicothe, Peoria county, Ill.; capital stock, $50,000; build, own and operate waterworks and electric light and power plants in Chillicothe, Ill.

Municipal Construction company, Peoria, Ill.; capital stock, $100,000; constructing and operating waterworks, electric light plants, street car lines, sewers, drainage, and contracts for building same

Lincoln Electric Railway company, Lincoln, Neb.; capital stock $400,000; continuing the business of the Lincoln electric railway and rebuilding lines of the standard railway as an electric street railway.

Standard Electric corporation, Minneapolis, Minn., capital stock $10,000; buying, selling and dealing in machinery, electrical or otherwise, doing a general business in mechanical and electrical appliances.

Trumbull Electric Railroad company, Cleveland, O., Warren and Niles, Ohio, branch office; capital stock $150,000; constructing street railroad in Warren and Niles, furnishing electricity for power and light, etc.

Ford-Washburn Storelectro company, Cleveland, O.; capital stock $1,500,000; manufacturing and dealing in electrical devices, etc., to operate cars by electricity or otherwise, etc. Incorporated in W. Virginia.

Holliston Gas & Electric company, Holliston, Mass.; capital stock $8,000; manufacturing, generating, distributing and selling gas and electricity for light and power, also for heating, cooking, chemical and mechanical purposes.

Commercial Construction company, Portland, Ore.; capital stock, $30,000; to carry on and conduct the business of generating, making, transmitting, furnishing and selling electricity for the purpose of lighting and power, and transmission of power.

Mount Hood Railway company, Portland, Ore.; capital stock $250 000; construct and equip railroad, telegraph, telephone and power lines from East Portland, in the county of Mullnomah, Ore., easterly to Pendleton, Umatilla county, Ore., the same to be operated either by steam, electricity or other motive power.

ELECTRIC LIGHTING.

Madrid, Spain, has 28,000 electric lamps.

It is proposed to establish an electric light plant at Gallatin, Tenn.

The Carrollton, Ga., Light & Power company will, it is said, enlarge its plant.

An addition to the electric light system of Gainesville, Ga., is contemplated.

An isolated plant is to be established at Harvard University, Cambridge, Mass.

Local business men are talking of installing an electric light plant at Georgetown, Ky.

A movement is on foot to establish an electric light plant in Healdsburg, Cal., with incandescent and arc dynamos.

Col. W. A. Sheldon, general agent of the Schuyler Electric company, reports that he has just increased the Marion, O., plant by 35 arcs.

A cablegram from London states that Sir Edward Watkin has built a private chalet on the extreme of Summit Snowden, where he is arranging what he claims will be the most powerful electric light in the world, which will be visible over a great part of Wales, England and even into Ireland.

The Plainfield, N. J., Electric Light company has assigned its street lighting contracts and business of every description to the Plainfield Gas & Electric Light company.

ELECTRIC RAILWAYS.

It is rumored that another electric railroad is to be built at Austin, Tex.

It is expected that the Lawrence, Mass., electric road will be in operation by the middle of July.

The United Electric Street Railway company of Nashville, Tenn., is building a number of extensions to its lines.

Twenty thousand dollars has been raised for the new electric railroad in Salina, Kan., and it is expected that the work will soon be begun.

Eastern capitalists are said to be negotiating for the purchase of the Florence, Ala., dummy line, with the idea of converting it into an electric road.

The Salt Lake City, Utah, Street Railway company at its annual meeting decided to convert the Third South street car line into an electric road.

A company has been organized at Sonomish, Washington, to build an electric road from Sonomish to Port Gardner. The capital stock is $50,000.

An enthusiastic meeting of the most prominent citizens of Santa Cruz., Cal ,was held recently at which it was decided to incorporate a company to construct and operate electric street car lines in that city.

A complete system of colored lights will be introduced on the electric cars in Minneapolis, Minn., by which each line will be denoted by the color of incandescent light globes on the front and rear of the car. At present the system is partially in use.

Galveston, Tex , has 35,000 people and forty miles of electric street car lines in operation. It is claimed that this forms the largest percentage of electric railway mileage to the number of inhabitants of any city in the country having a population of over 20,000.

A new street railway company has been formed at Bloomington, Ill. It will be known as the Citizens' Railway company, the object of which will be the construction and operation of an electric street railway capital stock, $250,000. The organizers of the company are James S. Neill, F. M. Churchill, and George W. Stubblefield. The enterprise is undertaken under the auspices of the Bloomington Fair association, and the first line to be constructed will be one to connect the fair grounds with the city.

The highest elevated railroad in the world, says London *Industries*, is about to be built in Naples. It is intended to connect the central part of Naples with the Corso Vittorio Emanuele. It is designed by Adolfo Aveno, civil engineer, and the estimated expense will be about £200,000. The road will be suspended from towers 100 metres high, in which will be elevators to carry passengers to the station. The road will be operated by electricity, generated by the force of the waterfall of the River Sorreno.

The Berlin Tramway company of Berlin, Germany, is considering the advisability of substituting electric cars for horse cars in Berlin. The company has now dispatched its chief engineer to Buda Pesth to study the system of electric tramways in that city (illustrated in the WESTERN ELECTRICIAN of April 25th), which has proved to be a commercial success, this being considered the first occasion that such has been the case on the continent. In case the system in operation in Buda Pesth is found suitable for Berlin, the company proposes to adopt it gradually and dispense with horse cars.

ELECTRIC MINING.

The Sperry Electric Mining company has recently shipped to S W. Little, Littles, Ind., a twenty-five horse power direct blow machine. This generator for this plant has sufficient capacity to run six machines, although but four will be installed at present.

Electric pumps for mining operations are run successfully in California, at the Gover mine in Amador county. The plant consists of a three foot Pelton wheel running under 340 feet head, connected to a fifty horse power Edison generator, which operates a system of pumps on the 400 and 700 foot levels, throwing more than 200,000 gallons of water per day. The pumps give entire satisfaction.

The census department returns for Pennsylvania make an excellent showing for bituminous coal mining. The bulletin shows the output to have been 36,174 089 short tons in 1889, nearly double that reported at the tenth census. The total value of the output is given as $27,953,215, or an average of 77.2 cents per short ton at the mines, against $18 567,129 in 1880, or an average of 100.8 cents per ton at the mines. The average number of persons employed in 1889 was 53,780, against 33,248 for 1880, the amount paid for wages in 1889 being $21,142,051, against $10,863,583 for 1880.

The *Mechanical News* asks the question, "Is there an aluminum craze?" and answers thus: An indifferent observer might be led to think that such is the case. Many people have apparently persuaded themselves that the man of the twentieth century will not only discard every other motive power but that of electricity, for all the purposes of life, but that one material, likewise, will serve him for every use; that his buildings, engines, ships, vehicles, and utensils, if not his clothing will all be of aluminum. But it will be found as in many similar cases, that the popular estimate of the capabilities of the metal is formed without strict inquiry as to its limitations. That it has

great utility is not to be disputed; but thus far aluminum bronze, consisting of ninety parts copper and ten parts aluminum, has been found of more practical value relatively to its cost; and it has been further ascertained that a very slight addition of copper greatly increases the tensile strength of the alloy, with but trifling increase of weight. Meanwhile, we are almost daily informed of new methods of extracting aluminum from clay, at such reduced expense that if the calculations of the inventors are realized, it ought speedily to become a cheap and common instead of a rare and costly metal. It is still quoted at about $1.50 per pound; but a leading producer of aluminum recently made public a very close and detailed estimate, showing that even in the present state of the art, the actual first cost of the metal, if the business were conducted on a sufficiently large scale, might be brought as low as 20 cents per pound."

TELEPHONE.

A franchise has been granted by the city to the Sunset Telegraph and Telephone company to erect poles and conduct a system of telephones in the city of Centralia, Cal.

MISCELLANEOUS.

The Consolidated Electric company of Birmingham, Ala., has been incorporated with a capital of $500,000.

The Thomson-Houston International Electric company has sent word to Prof. Elihu Thomson that the first prize of 100,000 francs in the competition electric meter test, under the auspices of the Paris municipal council, has been divided between the Thomson and Aaron meters.

The Portland, Ore., Industrial Exposition will hold its third annual exhibition from September 17th to October 17th. Efforts are making to secure a complete electrical exhibit. The building will this year, for the first time, be lighted entirely by electricity, 100 Thomson-Houston arc and 600 Edison incandescent lamps being used.

A dispatch from Des Moines, Ia, June 4th, says: "James Campbell and Evan Evans, both prominent farmers of Washington township, Adair county, while returning home from Prescott, Ia., were caught in a terrific thunderstorm. Mr. Campbell was instantly killed by lightning and Evans was severely stunned, but rallied and will live."

At Fiume, Austria, the Vienna Electrical company is putting in an installation to operate a large elevator and to light the town and harbor. There will be three alternating current generators of the Zipernowsky type, each of 80,000 watts capacity with an electromotive force at the terminals of 2,000 volts, and a rotary speed of 360 turns per minute, with the accompanying exciting machines. The plant is to be in operation by August.

Alluding to the place of electricity in modern warfare an exchange says: No war ship with any pretension of modern equipment is without an electric plant. The heavy guns, which heretofore required the services of several lusty men to point, are now moved by an electric motor. The gun captain can himself, by moving a small lever located at the back of the gun, point it in any direction desired. The advantage gained is not so much in the fact that the gun can be moved quickly as that it is under the control of one mind. Complexity is giving way to simplicity, and in order to have every part of the ship do its work at the proper instant, the captain, ensconced in the conning tower, can place himself in communication with any part of the vessel by means of the telephone.

At Magdeburg, in Germany, there is an electrical testing establishment which has been in operation for nearly a year. Like the associations for the inspection of boilers, it undertakes to make for its members yearly inspections of electrical installations. In this way it has accomplished very useful work for the owners of electrical works. Its influence has been the more powerful in consequence of the fact that it is entirely independent of electrical firms, and can therefore give an unbiased opinion. The activity of this establishment is felt throughout the whole of Germany. Its work consists in examining and reporting on the estimates for electrical installations. It affords advice and information concerning electrical apparatus, and gives its members, by means of circulars, the benefits of the experience which it has gained in carrying out the inspections.

The well-known French engineer, M. Marcelhacy, has made some additional improvements in diving apparatus, and these have received the approving indorsement of the French authorities. M. Marcelhacy's plan is to fix a light but powerful incandescent lamp on the top of the helmet, so that the diver's hands are at all times free for work; the lamp is connected by a conductor with a battery either on shore or in a vessel above, as the case may be. An equally ingenious feature is a new method of connecting the helmet with the dress without any loose parts, this being effected by means of only one water-tight joint, instead of two, as in the ordinary dress. Another advantage presented in this device consists in the upper part or collar of the India rubber dress being gripped in between the lower rim of the helmet and the upper rim of the breastplate, and there held fast against any liability of accident or displacement by gripping pieces attached to the breastplate.

TRADE NEWS.

The Lowe-Geeling Electric company of Neosho, Mo., will install one of its 50 light arc and two 10 horse power motor dynamos in the Lone Elm White Lead Works at Joplin, Mo., which is said to be the largest establishment of the kind in the country.

The Partrick & Carter company has arranged a general Canadian agency with the Toronto Construction & Electrical Supply company of Toronto, Ont. This company will carry in stock annunciators, alarms, bells, pushes and batteries, manufactured by Partrick & Carter company.

One of the most recent additions to the list of eastern electrical companies having Chicago offices is the Electric Construction and Supply company of New York, which has opened a western branch at 622 and 623 Phenix building, with McDougall & Cummings as managers. This is the company that supplies the well known Ward arc lamp for incandescent circuits. The company is now making a lamp adapted to street railway circuits, and has also perfected new lamp designed to burn on an alternating circuit. The latter has been indorsed by all central station people who have tested it.

"Mechanically and electrically perfect" is the claim made for the new "Jewel" incandescent lamp, of which Wm. Hood, 239 La Salle street, Chicago, is the general agent. The lamps are made for any voltage, of any candle power and to fit any socket. They are made in Chicago "under the specical supervision of one of the oldest and best manufacturers in this country." Mr. Hood has taken charge of the sales department with characteristic vim and energy, and it will be strange indeed if he does not find a ready market for the meritorious product that he has in hand.

Many electric light stations throughout the country bear evidence of the excellence of the iron construction work of the Berlin Iron Bridge company of East Berlin, Conn. Among these are the Norwalk Electric Light company, Norwalk, Conn.; Thomson-Houston Electric Light company, Boston; Narragansett Electric Lighting company, Providence, R. I.; Connecticut Electric company, Waterbury, Conn., and the Lynn Gas & Electric company, Lynn, Mass. The Providence station is a particularly fine example of the Berlin company's work and is shown in one of the illustrations of the elaborate new catalogue just issued by the company, which will be sent to any address on application. This company has a high reputation for the quality of its work and has designed and constructed some of the largest manufacturing buildings in the country.

BUSINESS.

The new catalogue of the Card Electric Motor & Dynamo company of Cincinnati gives a number of beautiful illustrations of the excellent motors and dynamos manufactured by that company.

The repair and recalibration of fine instruments is being made a specialty by the Chicago Electric Manufacturing company, 73 W. Jackson street, a room having recently been prepared for this purpose. A fine line of work has already been secured.

The Northwestern Electric Specialty company representing the Economic incandescent lamp, has prepared a small, light wooden box, just large enough to hold a lamp for distribution as "samples." They will be sent to any address that may be sent them.

Jas. McLaughlin, 50 North Clinton street, reports a large amount of repair work on hand, a large generator armature having recently been sent him for repairs from a city in Connecticut, his reputation for careful work having reached that distance from home.

Louis Blatz, 103 West Monroe street, Chicago, recently purchased the business of Anderson Bros, brass founders. Mr. Blatz is prepared to give special attention to model makers or to persons who are experimenting on electrical specialties. The foundry is being fitted up with all the latest appliances, and every effort will be made to turn out work in the best possible shape, and in the shortest possible time.

S. Taussig, 45 River street, representing the Synovial oils for dynamo and engine use, cylinder oils, grease, etc., reports a very active season thus far, and with a most flattering prospect for the future The building occupied by Mr. Taussig has been almost entirely rebuilt, and is now known as the "San Diego." Mr. Taussig has an office on the second floor. His company has had made for free distribution a thermometer, which can be had on application, either in person or by mail.

Milliken Bros., New York City and Chicago, report a large increase in the demand for their patent poles for electric street railway and electric light use. They have lately booked orders for a large number of poles for the Pittsfield Electric Light company, a new form of combination pole for both street railway and electric light wires. They have also received orders for Los Angeles, Cal., Little Rock, Ark., St. Louis, Plainfield, N. J., and Brooklyn. Parties in Wilmington, Del., have found it to their advantage to use poles somewhat similar to the large poles which this concern lately furnished to Passaic, N. J., and which are known as the largest street railway poles in the world. The arms for these poles are only a trifle shorter than the poles supplied to Passaic. They are furnishing a large number of poles to South American countries, and report business very brisk.

ELECTRICAL PATENTS.

Issued June 2, 1891.

453,190. Advertising Device. Sidney D. L. Jackson, Youngstown, O

453,216. Electric Street Car Motor. Jabea F. Shawhan, Dayton, O.
The invention consists in the combination, with a tram car and a constantly revolving electric motor thereon, of independent car wheels and a speed reducing device between each car wheel and the motor.

453,225. Electric Connector. Frank Wheeler, Meriden, Conn.

453,242. Magneto Electric Machine William Humans, Cambridge, Mass

453,248. Bracket for Electric Lamps. Thomas C. Smith, Philadelphia, Pa.

453,260. Electro Magnetic Engine. Charles E. Kells, Jr., New Orleans, La.

453 261. Telegraph Receiver. Charles Langdon-Daves, London, England.

453,281. Safety Device for Dynamos. Charles G. Young, New York, N. Y.
The first claim reads as follows:
"In a system of electrical distribution, the combination of an electric generator, a main line in circuit therewith, and a cut out in circuit with said generator and controlled by a device in continuous circuit with said main line and the ground."

453,286. Pole for Electric Wires. Charles A. Lieb, New York, N. Y.

453 287. Automatic Switch for Electric Motors. Roderick Macrae, Baltimore, Md.

453,317. Method of Magnetic Separation. Henry C. Townsend, New York, N. Y.

453,318. Switch for Electric Motors. Ferdinand A. Wessel, Brooklyn, N. Y.

453,319. Automatic Starting Switch for Electric Motors. Ferdinand A. Wessel, Brooklyn, N. Y.

453,320. Automatic Starting Switch for Electric Motors. Ferdinand A. Wessel, Brooklyn, N. Y.

453,323. Electric Current Tester. William H. Ebert, New York, N. Y.
Claim one is given:
"The herein described testing device, comprising a voltaic pair permanently connected by a yoke, and a pair of flexible conductors, one for each member of the pair, fixed in electric contact therewith."

453,326. Insulating Cover for Trolley or Conducting Wires for Electric Railways. Albert L Ide, Springfield, Ill.

453,337. Detachable Rosette. Charles E. Davis, Chicago, Ill.

453,349. Switch Board for Electric Arc Light Stations. Robert F. Sawyer, Chicago, Ill.

453,367. Starting Switch for Electric Motors. Clark C. Haskins, Chicago, Ill.

453,416. Electric Annunciator System. Louis M. Pinolet, Brooklyn, N. Y.

453,430. Electrical Type Writing Machine. James F. McLaughlin, Philadelphia, Pa.

453,433. Holder for Telephone Receivers. Frank T. Tinning and William K. S. Tinning, Toronto, Ontario, Canada.

453,447. Railway Signaling Device. William A. Luby, Kalamazoo, Mich.

453,455. Electric Lamp Socket. Le Roy S. White, Waterbury, Conn.
Claim one is:
"A socket for electric lamps, comprising a frame or casing, contact plates for closing and breaking the circuit, binding posts for the attachment of the wires, a binding screw and a key, the said contact plates and binding posts being secured to the end of the socket frame or casing by the binding screw."

453,466. Circuit Closer for Burglar Alarms Edwin A. Darling, Hopedale, Mass.

453,476. Electrical Apparatus for Surgical Purposes. Cornelius B. Harness, London, England.
The invention consists in the method of providing for the treatment of patients preparatory to and during surgical and dental operations by first causing an electric current to pass through the body of the patient between any two parts thereof, and then changing the path of the current so that it will pass through the patient's body between one or both of the said parts, and the part operated upon.

453 483. Telephone Circuit. William W. Jacques, Newton, Mass.
The claim reads:
"The combination, with two metallic circuits of two pairs of condensers, one pair for each circuit, and one plate of a separate condenser being in contact with each line wire, while the opposite or free plates of the pair of condensers of each circuit are connected by a metallic loop, and the two loops thus formed are connected by a third."

453,484. Electrical Register for Measuring Pumps. Robert Jewell, London, England.

453,572. Automatic Electric Switch. Robert Baumann, St. Louis, Mo.

453,578. Electric Railroad Signal Alarm. Newton S. Chapman, Kansas City, Mo.

453,581. Telephone Transmitter. Philip Fitzsimons, Birmingham, Ala.

453,583. Electric Arc Lamp. William Hochhausen, Brooklyn, N. Y.
Of the thirty-nine claims the thirty-eighth is given:
"In a hanger board for electric lamps, spring contact sockets sustained on suitable conducting plates or blocks fastened to the top of an insulating plate, and contact springs extending from such blocks or plates and forming terminals of a cut-out switch, located also on the plate."

453,597. System of Electrical Distribution. Frederick A. La Roche, Philadelphia, Pa.

453,601. Sextuplex Telegraph. Thomas A. Edison, Menlo Park, N. J. Application filed June 2, 1877.
The invention relates to the arrangement of electro magnets and circuit connections, in which one responds to reversals in the direction of the flow of the current in the line and the other two sets of devices to an increase or decrease in the strength of the current independent of its direction.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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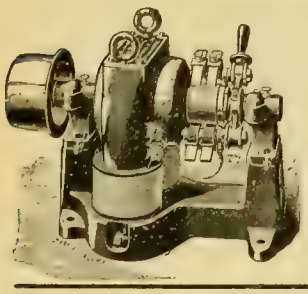

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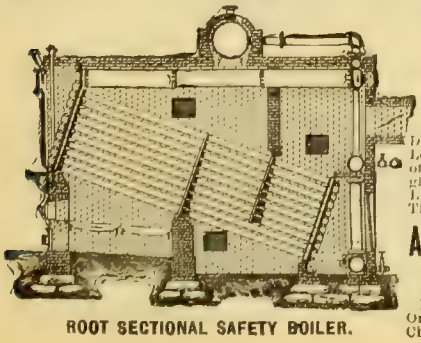

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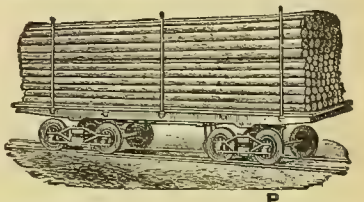

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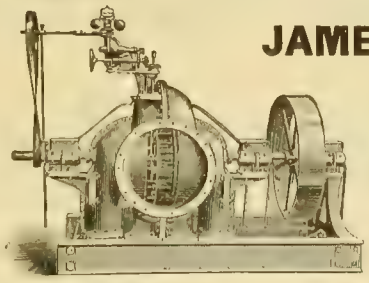

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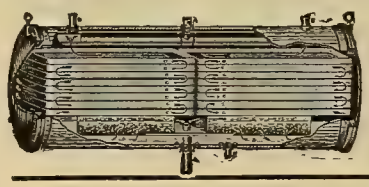

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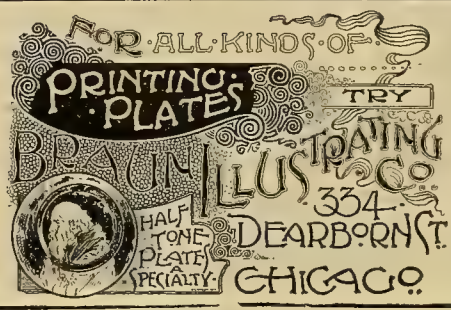

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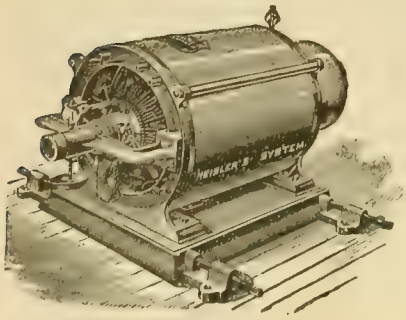

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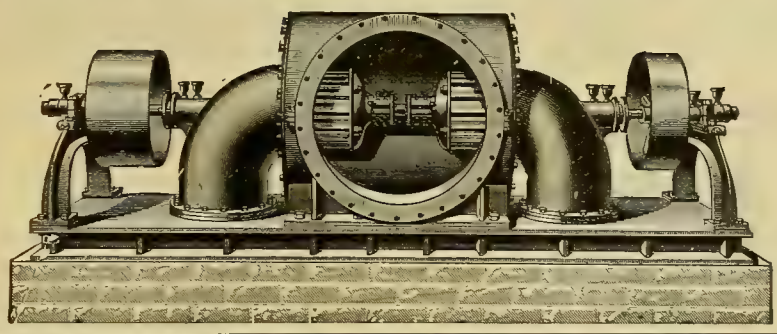

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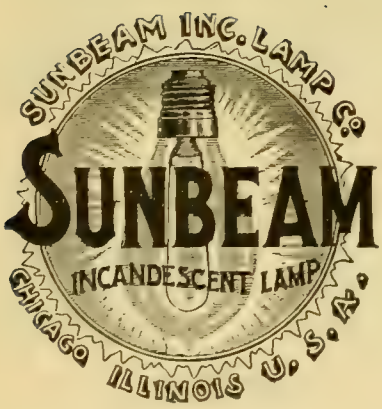

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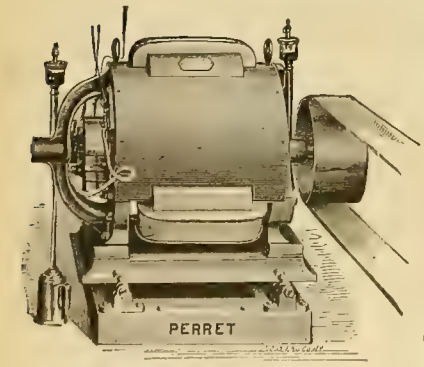

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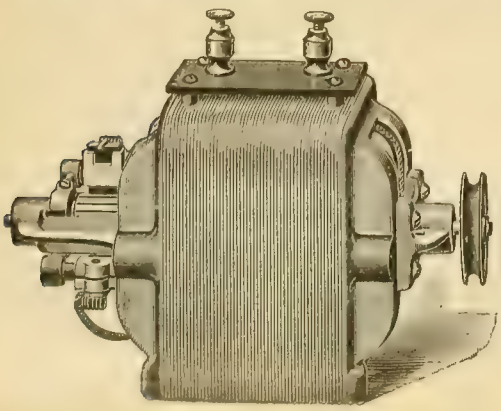

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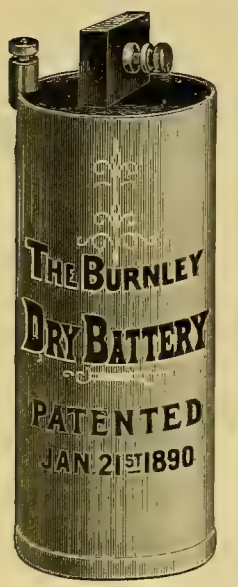

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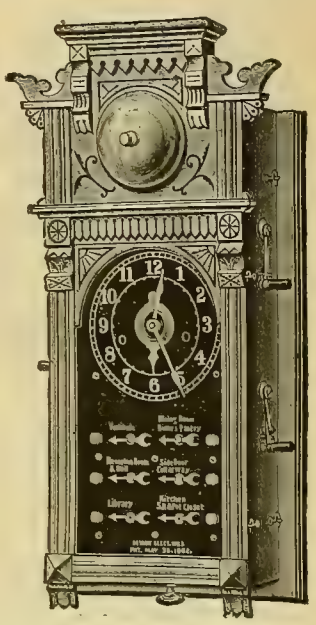

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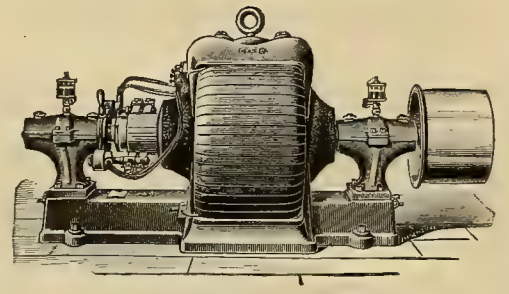

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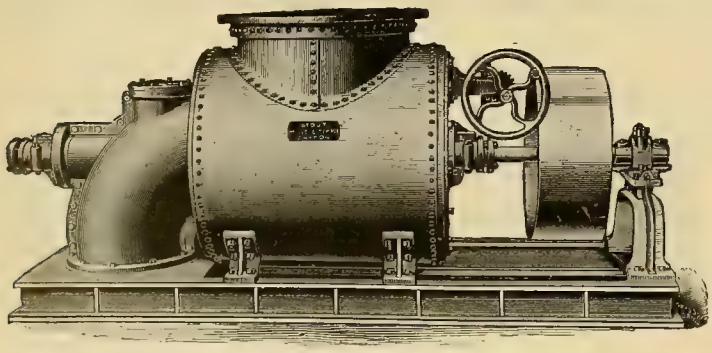

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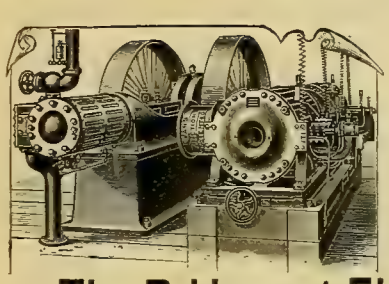
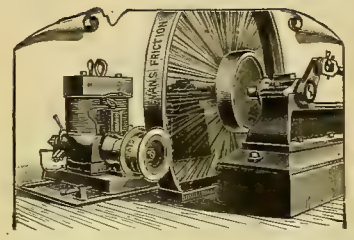
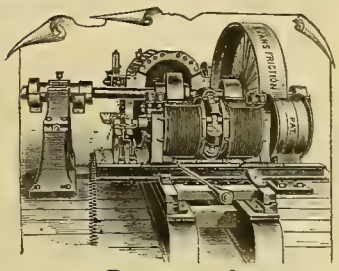
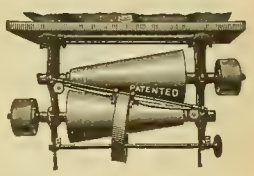

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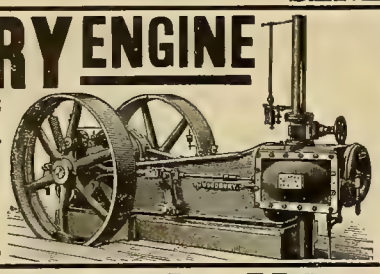

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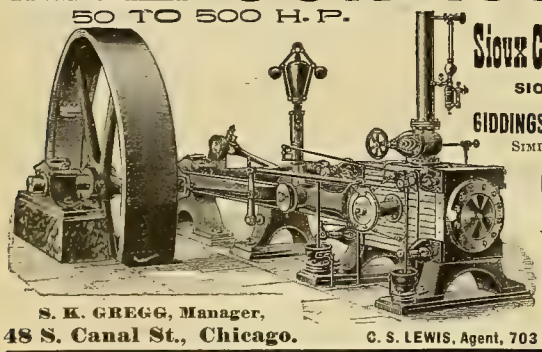

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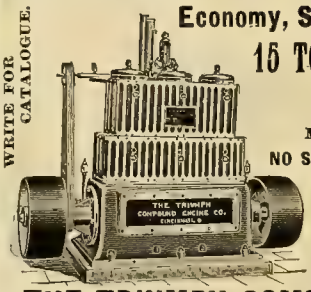

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We have not, thus far, found it necessary to take advantage of the guarantee furnished by you, as to the life of these porous cups, as they have outlived the time specified in the agreement. Yours respectfully,

(Signed) F. G. BEACH, Gen'l Supt.

CHICAGO TELEPHONE COMPANY,
Telephone Building, 203 Washington St.,
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WESTERN ELECTRIC CO., Chicago.

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(Signed) J. J. NATE,
Purchasing Agent.

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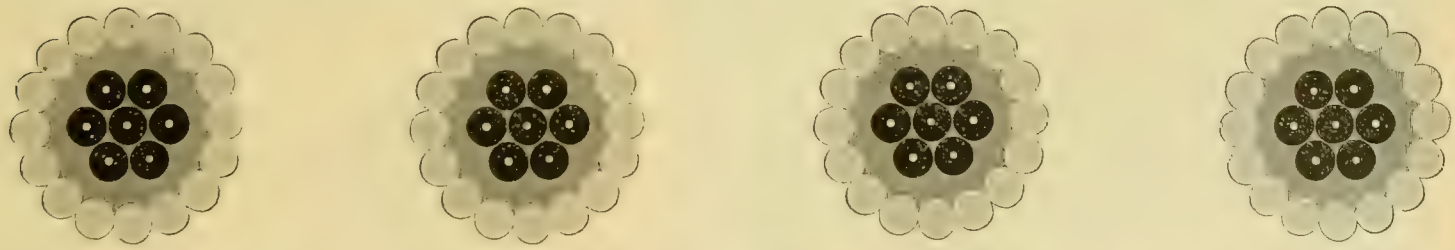

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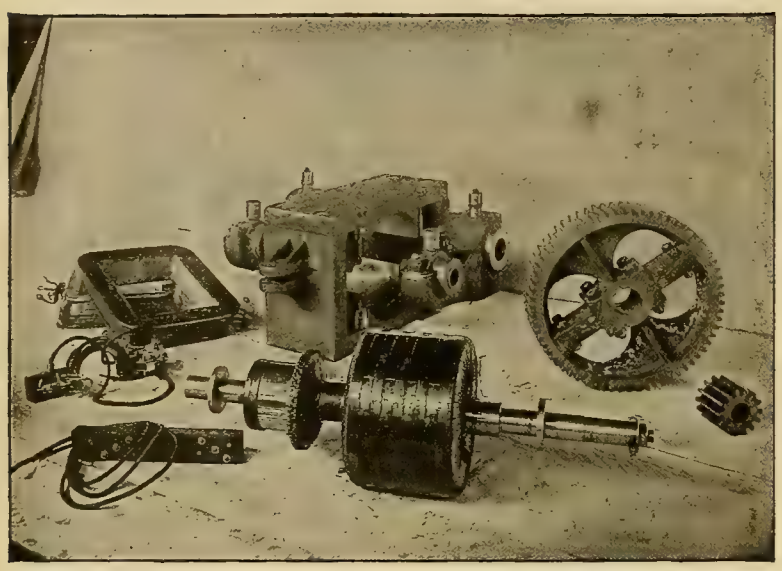

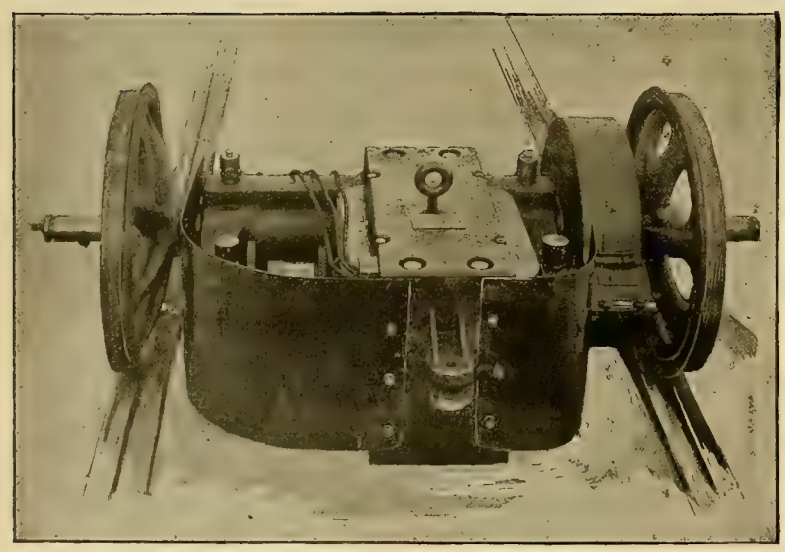

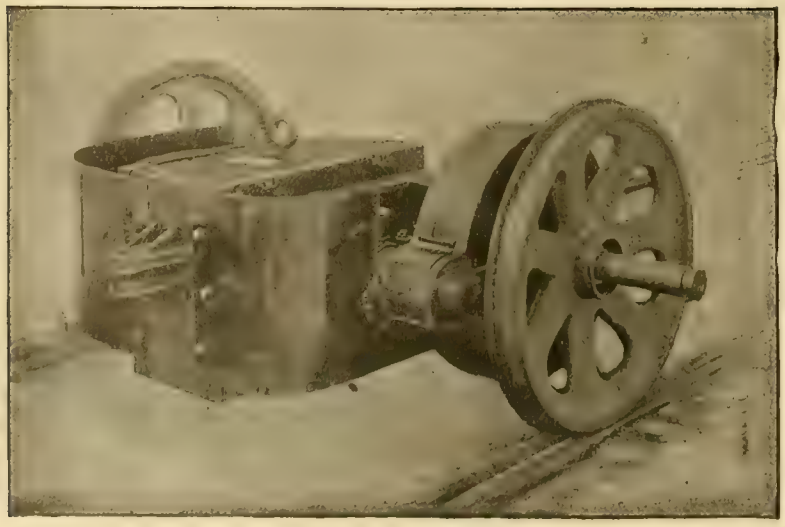

The Intermediate Shaft, Pinion and Gear have been discarded.

The Armature Pinion and Axle Gear are now enclosed in a dust-proof case filled with oil.

Reducing to a minimum the cost for repairs and absolutely eliminating the objectionable noises incident to all other systems.

The Armature speed has been reduced from 1200 to 500 revolutions per minute.

The Railway Motor, as now constructed, comprises less than a dozen parts.

The construction of the Armature avoids the possibility of a burn-out, except by malicious carelessness, and when damaged, can be readily repaired by a novice.

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General Western Agents for

THE PERKINS ELECTRIC LAMP CO.

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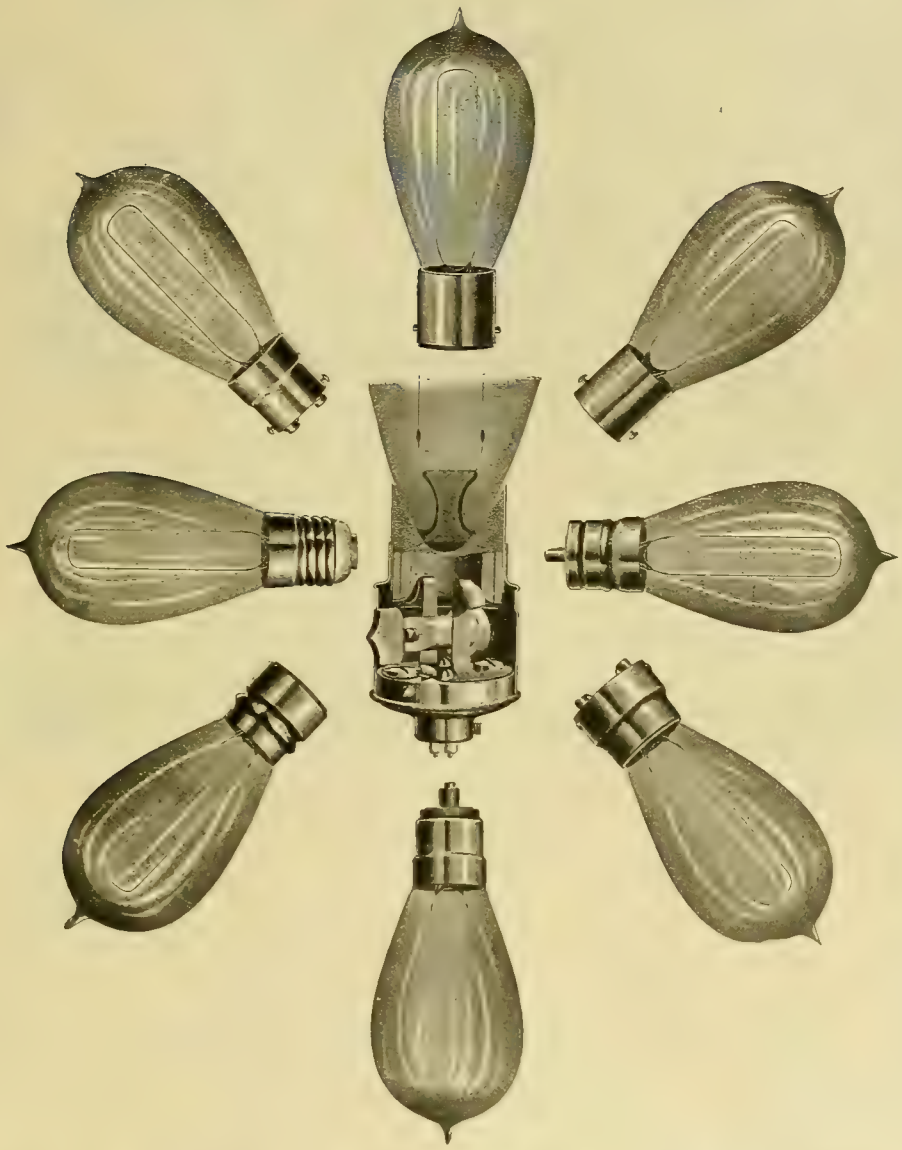

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171 RANDOLPH ST.
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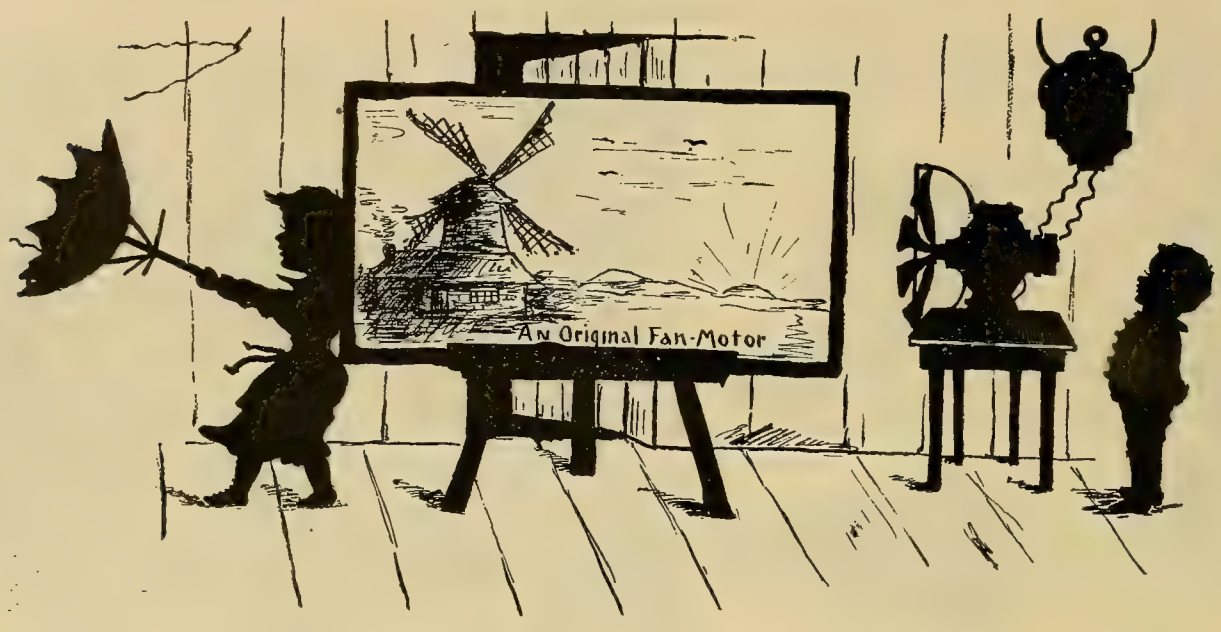

STANLEY ELECTRIC MANUFACTURING CO.

HENRY HINE, General Manager.

PITTSFIELD, MASS., June 1, 1891.

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We take pleasure in informing you that we have made The Electrical Supply Co. of Chicago exclusive selling agents for our transformers and A. C. fan motors in a large part of the West. Our principal object in making this arrangement was to enable stations in the West to obtain our goods more promptly, and at less expense for freight. The Electrical Supply Co. will carry a sufficient stock to fill all orders promptly, and stations will have the benefit of the same prices from them as if purchased direct from us.

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STANLEY ELECTRIC MFG. CO.

DOUBLE CARBON LAMPS

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ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive, and unsatisfactory.

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CARBONS FOR ARC LIGHTING,
ETC, ETC, ETC.

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ARC LIGHTING

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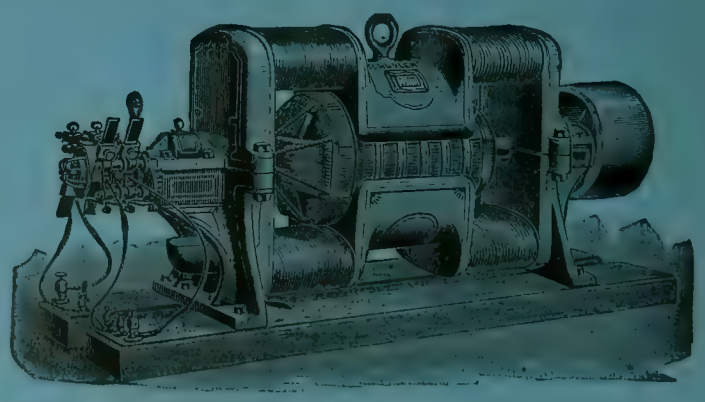

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A Pure White Steady Light.

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Vol. VIII. CHICAGO, JUNE 20, 1891. No. 25

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4,150	VERMONT,	2,200
12,800	TENNESSEE,	1,485
1,500	SOUTH CAROLINA,	NONE.
18,450	TOTAL,	3,685

FIVE TIMES as many of the Thomson-Houston System as of

ALL OTHERS COMBINED.

The figures referring to "total of all systems," taken from table published in August number of "Electrical Industries," for year 1890, are of undisputed accuracy.	Total of all systems.	Thomson-Houston System.	
		Number.	Percentage to total of all systems.
Vermont, - - - -	6,350	4,150	$65\frac{3}{10}$ per cent.
Tennessee, - - - -	14,285	12,800	$89\frac{1}{2}$ per cent.
South Carolina, - -	1,500	1,500	100 per cent.

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1333 F Street, Washington, D. C.
115 North 3d Street, St. Louis, Mo.

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Brush Electric Co.

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Cleveland Aluminum Co.
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Hawkeye Electric Mfg. Co.
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Schuyler Electric Co.
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Great Western Electric Supply Co.
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Butler Hard Rubber Co.

Insulators and Insulating Materials.
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Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
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Munsell & Co., Eugene.
New York Insulated Wire Co.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Paint Co.
Western Electric Co.

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American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
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Edison General Electric Co.
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New York Insulated Wire Co.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Buckeye Electric Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Heisler Electric Light Co.
Hood, Wm.
Knapp Electrical Works.
Monitor Electric Co.
Sawyer-Man Electric Co.
Southern Electrical Supply Co.
Sunbeam Incandescent Lamp Co.

Lamps, Incandescent—Contd.
Thomson-Houston Electric Co.
Western Electric Co.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.
Partrick & Carter Co.

Mica.
Munsell & Co., Eugene.

Mining Apparatus, Electric.
Bain Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Electric Mfg. Co.
Brush Electric Co.
Baxter Electric Motor Co.
Card Electric Motor & Dynamo Co.
Crocker-Wheeler Electric Motor Co.
C. & C. Electric Motor Co.
Detroit Electrical Works.
Edison General Electric Co.
Electrical Engineering Co.
Elektron Manufacturing Co.
Hawkeye Electric Mfg. Co.
Shawhan Machine Works.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Westinghouse Electric & Mfg. Co.

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Packing.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Holmes, C. H.
Standard Electrical Works.
Southern Electrical Supply Co.
Western Electric Co.

Poles.
Brownlee & Co.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Engineering Equipment Co.
Great Western Electric Supply Co.
Holmes, C. H.
Milliken Bros.
Sterling, W. C.
Star Iron Tower Co.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Knapp Electrical Works.
Northwestern Elect. Specialty Co.
Partrick & Carter Co.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Separators, Steam.
Pond Engineering Co.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Street Ry. Equipment.
Minneapolis Street Ry. Co.

Supplies, Electric Railway.
Electric Merchandise Co.
Electric Railway Specialty Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Western Electric Co.

Telegraph Apparatus.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Standard Electrical Works.
Western Electric Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Telephones, Non-Electric.
Bostwick & Burgess Mfg. Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
Stanley Electric Mfg. Co.

Trucks, Electric Car.
Detroit Electrical Works.
Edison General Electric Co.
Short Electric Railway Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Hunt Machine Co., Rodney.
Leffel & Co., James.
Stilwell & Bierce Mfg. Co.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.
Partrick & Carter Co.
Roebling's Sons Co., Jno. A.

THE NATIONAL CARBON CO

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

Cleverly 1018 CHESTNUT ST. PHILA.

Electric Specialties.

—WE MAKE—

Electric Supplies Under Contract.

REMEMBER

That the Western Electrician enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK.

MANUFACTURED BY MILLIKEN BROS.

59 DEARBORN STREET, CHICAGO.

Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K.K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

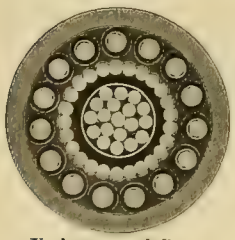
THOS. L. SCOVILL, New York Agent, - - - - 25 Park Place, NEW YORK.

THE INDIA RUBBER & GUTTA PERCHA INSULATING CO.

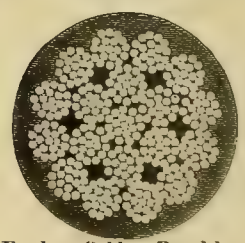
THE RUBBER USED IN

HABIRSHAW INSULATION

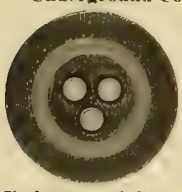
IS PURE PARA.



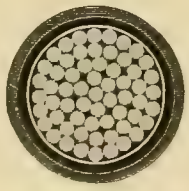
Underground Core.



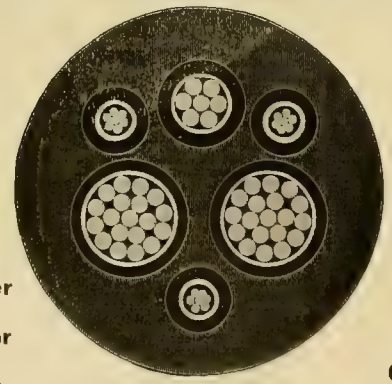
Feeder Cable. Brooklyn Edison Electric Light Co.



Underground Core. N. J. Central R. R.



Feeder Core. Broadway Theater.



Submarine Work. Edison Electric Light Co., Easton, Pa.

Naval Core. United States s. s. "Chicago."

Portable Cable. Broadway Theater.

Marine Core, used on Government Cruisers.

Naval Marine India Rubber Covered Wires.

Naval Land India Rubber Covered Wires.

PROMINENT INSTALLATIONS.

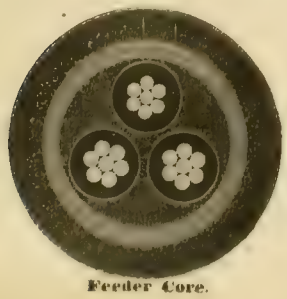
STANDARD INDIA RUBBER COVERED WIRES.

Feeder Conductor. "Drypla es." Grand Central Depot.

Adopted by the Navy Department, and thus far employed on board the United States steamships Trenton, Chicago, Boston, Yorktown, Pensacola, Philadelphia, Petrel, Atlanta, Baltimore, Newark, Vermont, Charleston, San Francisco, Concord, Bennington and monitor Miantonomah.

SOLID AND STRANDED CONDUCTORS, TAPED, BRAIDED, FLAME-PROOF.

The Habirshaw Insulation fulfills all requirements in places demanding the "Best," and in that field finds no successful competitors.

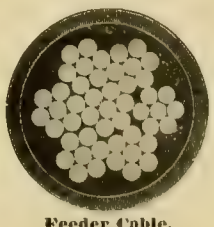


Feeder Core.

FACTORY: GLENWOOD, YONKERS, N. Y.

WM. M. HABIRSHAW, F.C.S., GENERAL MANAGER.

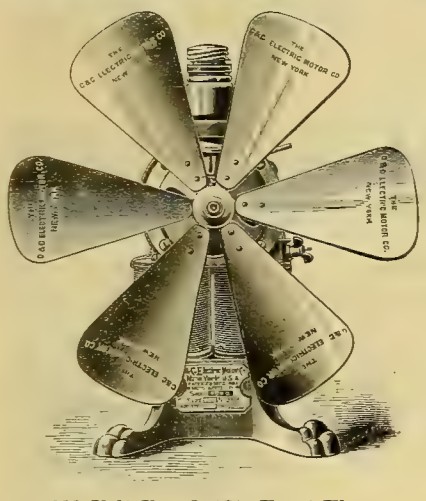
OFFICE: 315 Madison Ave., Cor. Forty-Second St., NEW YORK CITY.



Feeder Cable. Brooklyn Edison Electric Light Co

THE ELECTRICAL SUPPLY CO., Western Agents, 171 Randolph St., Chicago, Ill.

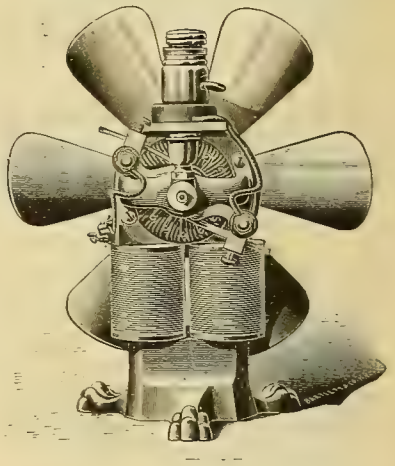
C. & C. FAN OUTFITS.



110 Volt Fan Outfit. Front View.

THE OLDEST AND BEST.

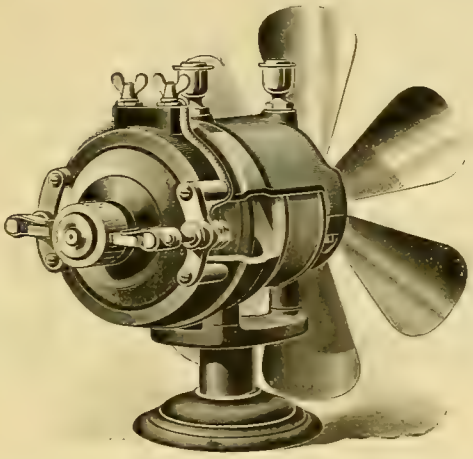
The season of 1891 marks the fifth year since the introduction of the C. & C. Fan Outfits.



110 Volt Fan Outfit. Back View.

Thousands in Operation in Every State and Territory in the Land.

With each season some improvement either Electrical or Mechanical has been made, until the Machine as placed this year on the market, is absolutely without defect.

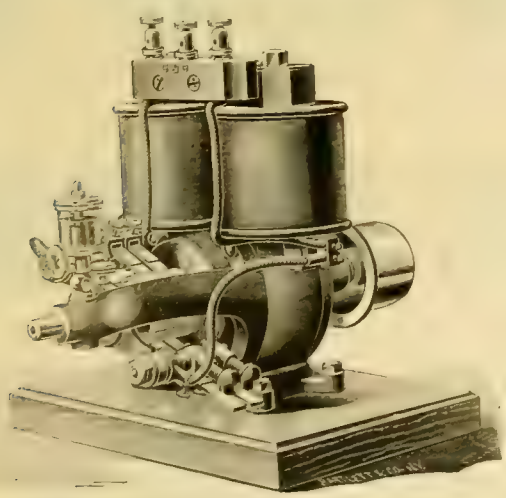


500 Volt Fan Outfit.

Wound for any direct current Circuit.

Finished in dipped brass, polished or nickeled.

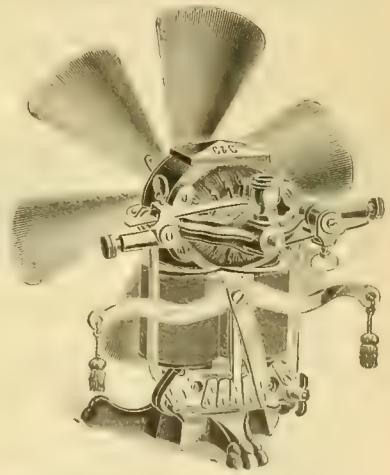
For Electric Railway and Power Circuits we are this year ready to supply a Fan Outfit designed especially for high Potential Circuits.



1-4 H. P. Motor for operating Ceiling Fans.

OFFICES:

BOSTON, 63 Oliver Street.
CHICAGO, Phenix Building.
DENVER, 1316 Eighteenth Street.
CINCINNATI, Cincinnati Electric Light Company.
ST. LOUIS, 411 N. 11th Street.
SAN FRANCISCO, 35 Market Street.
WASHINGTON, 609 Twelfth Street.



Constant Current Fan Outfit.

C. & C. ELECTRIC MOTOR COMPANY,

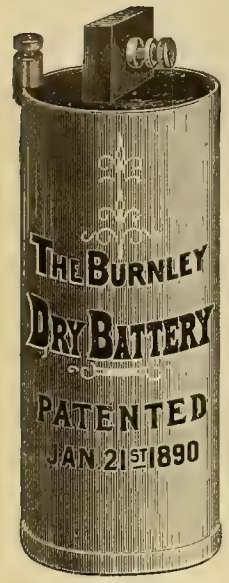
402 and 404 Greenwich Street, NEW YORK.

DETROIT ELECTRICAL WORKS,

DETROIT, MICH.,

Manufacturers of the Celebrated

UNIVERSAL FARADIC MEDICAL BATTERY,



using dry Burnley cell, thereby dispensing with the inconvenience and annoyance of fluids. Cases and all parts handsomely made and finished.

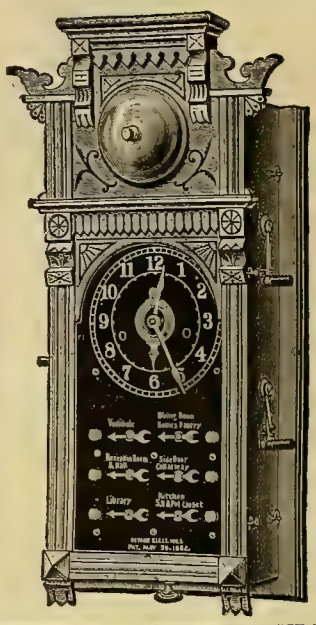
ANNUNCIATORS

for Hotels, Residences and Railroad Cars, in various styles and sizes.

These Annunciators are very simple and perfect in construction, have long life without repairs, and are in general use throughout the country.

Also manufacturers of Telephone, Telegraph and general Electrical Supplies and Merchandise, including Magnet and Annunciator Wire in all sizes and finish.

Bare Copper and Galvanized Iron Wire carried in stock. Prices quoted on application, and subject to change of market on Copper Wire.



AND STILL THEY COME.

Among our late sales are

38 "WARD" ARC LAMPS

TO THE CENTRAL R. R. OF NEW JERSEY.

185 "WARD" ARC LAMPS

TO THE H. B. CLAFLIN COMPANY OF NEW YORK.

SATISFACTION GUARANTEED.

In Corresponding please state Voltage and System. Immediate Shipment Guaranteed. Increased orders from all Central Stations using the lamp.

THE ELECTRIC CONSTRUCTION AND SUPPLY CO.,

Established 1881. **18 Cortlandt Street, NEW YORK CITY.**

Our St. Louis Branch:
Southern Electrical Supply Co.,

OKONITE
TRADE MARK.

823 Locust St.,
ST. LOUIS, MO.

NICKEL-PLATED

Speaking Tube Whistles.

WITH OR WITHOUT INDICATORS.

Our Kansas City Branch:
Gate City Electric Company,

OKONITE
TRADE MARK.

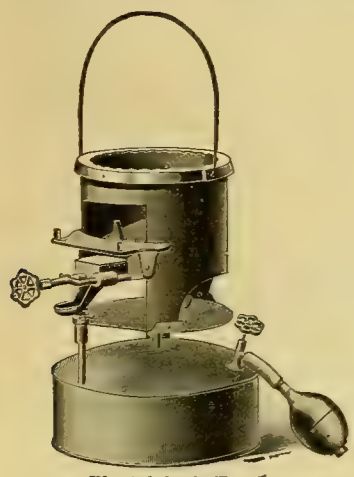
572 Delaware St.,
KANSAS CITY, MO.

WE HAVE A

LARGE STOCK

of these **SPEAKING TUBE WHISTLES** on hand, which we will dispose of at the following prices:

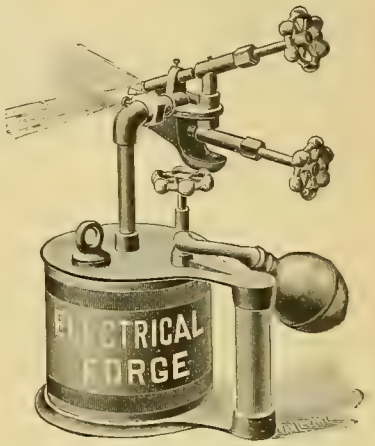
1	dozen	lots,	$2.00.
5	"	"	1.75.
10	"	"	1.50.
25	"	"	1.40.
50	"	"	1.35.
100	"	"	1.30.



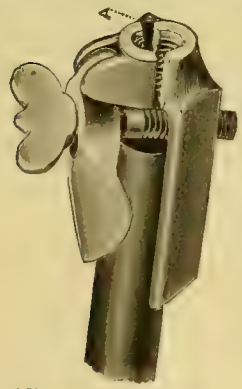
Electrician's Torch.

The ELECTRICIAN'S TORCH

Is safe, durable, easily repaired, has a reversible burner that can be used in any position and will not blow out in a gale of wind. Can be used as a Blow-pipe Torch or a Fan-tail Heater and can be instantly changed from an intense heat to a feeble flame, or the reverse.



No. 1. Helper Forge.



Upper Carbon Holder.

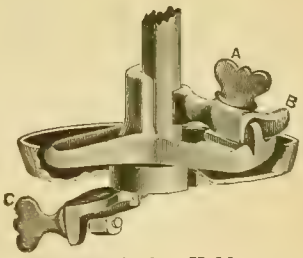
The No. 1 HELPER FORGE

Can also be used in the highest wind. One gallon of 74° deodorized gasoline will run it all day. It is made to stand hard work.

These

CARBON HOLDERS

Are designed especially for Thomson-Houston and Brush lamps, and are sold at very low prices. We also have a lot of Thomson-Houston lower carbon holder rings.



Lower Carbon Holder.

We are now exclusive Western Agents for

Commercial Fire-Proof Lamp Cord, Packard Incandescent Lamps, Bryant Sockets (all Porcelain and Brass), **Okonite Wire, Improved Candee Wire.**

Our Omaha Branch:
Western Electrical Supply Co.,

OKONITE
TRADE MARK.

418 S. 15th St.,
OMAHA, NEB.

CENTRAL ELECTRIC COMPANY,

116 & 118 Franklin Street,

CHICAGO.

Connected by Private Wire with Postal Telegraph-Cable Company's System.

Our Denver Branch:
Electric Power Transmission Co.,

OKONITE
TRADE MARK.

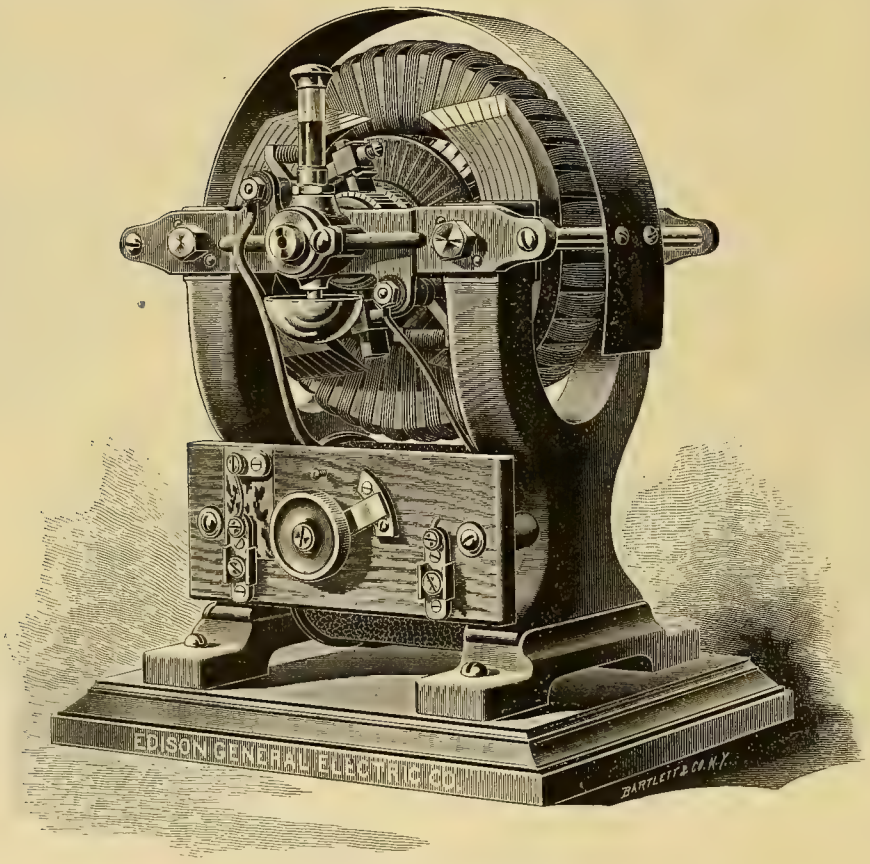
1722 Lawrence St.,
DENVER, COLO.

EDISON GENERAL ELECTRIC CO.,

Edison Building, Broad St., New York City.

NEW ELECTRIC MOTORS.

HIGHEST EFFICIENCY.



Independent Coils. No Sparking. Automatically Adjusted Brushes. Slow Speed.

Mechanically Perfect. Minimum of Attention and Repair.

Improved Lubrication. In sizes from 1-16 H. P. to 1-2 H. P.

Send for descriptive circular to the nearest District Office.

DISTRICT OFFICES:

Canadian District, Edison Bldg., Toronto, Can.
Central District, 173 and 175 Adams St., Chicago, Ill.
Eastern District, Edison Building, Broad St., New York.
New England District, 25 Otis Street, Boston, Mass.
Pacific Coast Dist., Edison Bldg., 112 Bush St., San Francisco, Cal.
Pacific Northwest District, Fleischner Bldg., Portland, Ore.
Rocky Mountain District, Masonic Building, Denver, Colo.
Southern District, 10 Decatur Street, Atlanta, Ga.

ALEXANDER, BARNEY & CHAPIN,

TELEPHONE BUILDING, 20 Cortlandt St., NEW YORK.

VOLTMETERS. TRADE A.B.C. MARK **AMMETERS.**

ELECTRICAL SUPPLIES.

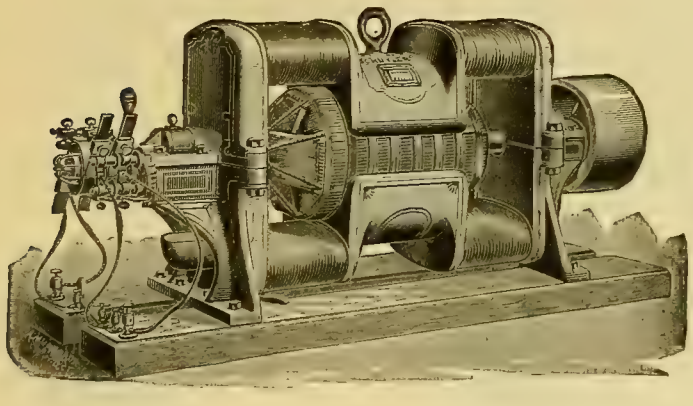
ARC AND INCANDESCENT LAMPS.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

MOONLIGHT SCHEDULE

FOR 1891

IN THE NEW EDITION OF THE

Dynamo-Tenders' Hand-Book.

NOW READY. PRICE $1. SEND FOR IT.

ELECTRICIAN PUBLISHING COMPANY,

6 LAKESIDE BLDG.,

CHICAGO.

ELECTRIC RAILWAY SUPPLIES

For All Systems.

EXCLUSIVELY.

SEND FOR CATALOGUE.

ELECTRIC MERCHANDISE CO.,

11 ADAMS STREET, CHICAGO.

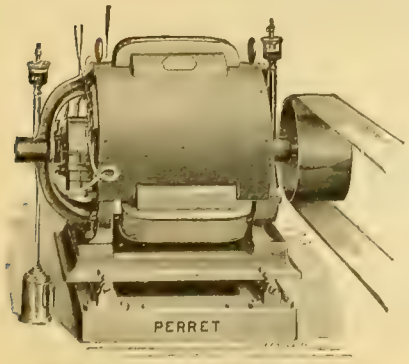
W. R. MASON, General Manager.

THE ELEKTRON MFG. CO.,

79 and 81 Washington Street, Brooklyn, N. Y.

—MANUFACTURERS OF—

Perret Electric Motors and Dynamos



Perret 20 H. P. Motor, Speed 550, Weight 1,300 lbs

LAMINATED FIELD MAGNETS, HIGH EFFICIENCY,
LOW SPEED, FULL POWER.

Motors of any size for any purpose. Factories equipped throughout with Electric Power Isolated Plants for Incandescent Electric Lighting.

—SELLING AGENTS:—

CHICAGO, ILL., The Electrical Engineering Co., 320 Dearborn St.
PHILADELPHIA, PA., Pennsylvania Machine Co., 29 N. 7th St.
WASHINGTON, D. C., J. U. Burkett & Co., 1409 N. Y. Ave.
ST. PAUL, MINN., F. J. Renz, 95 E. Fourth St.
NEW ORLEANS, LA., George Baquie, 140 Gravier St.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

— POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF —

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.
All operations of sawing, cutting, turning and polishing our new standards of

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies.

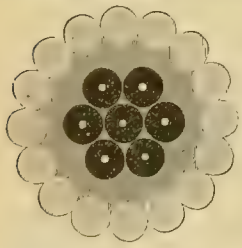
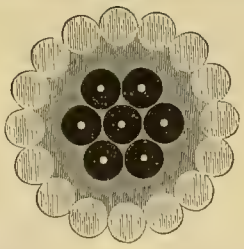
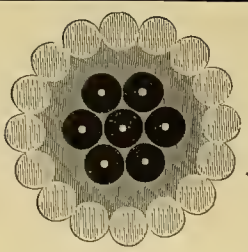
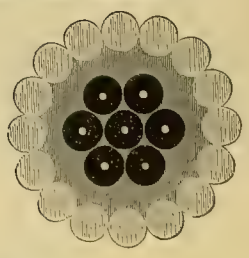
SEND FOR PRICES AND ESTIMATES.

FOR SALE BY THE CENTRAL ELECTRIC CO., CHICAGO.

To Electric Railway Companies:

We shall be pleased to make you quotations on Washburn & Moen's hard drawn copper trolley wire, and our own make of Weatherproof insulation feeder wires. Our Weatherproof wire is superior to any other wire of like character in the market.

WESTERN ELECTRIC COMPANY, CHICAGO. NEW YORK.

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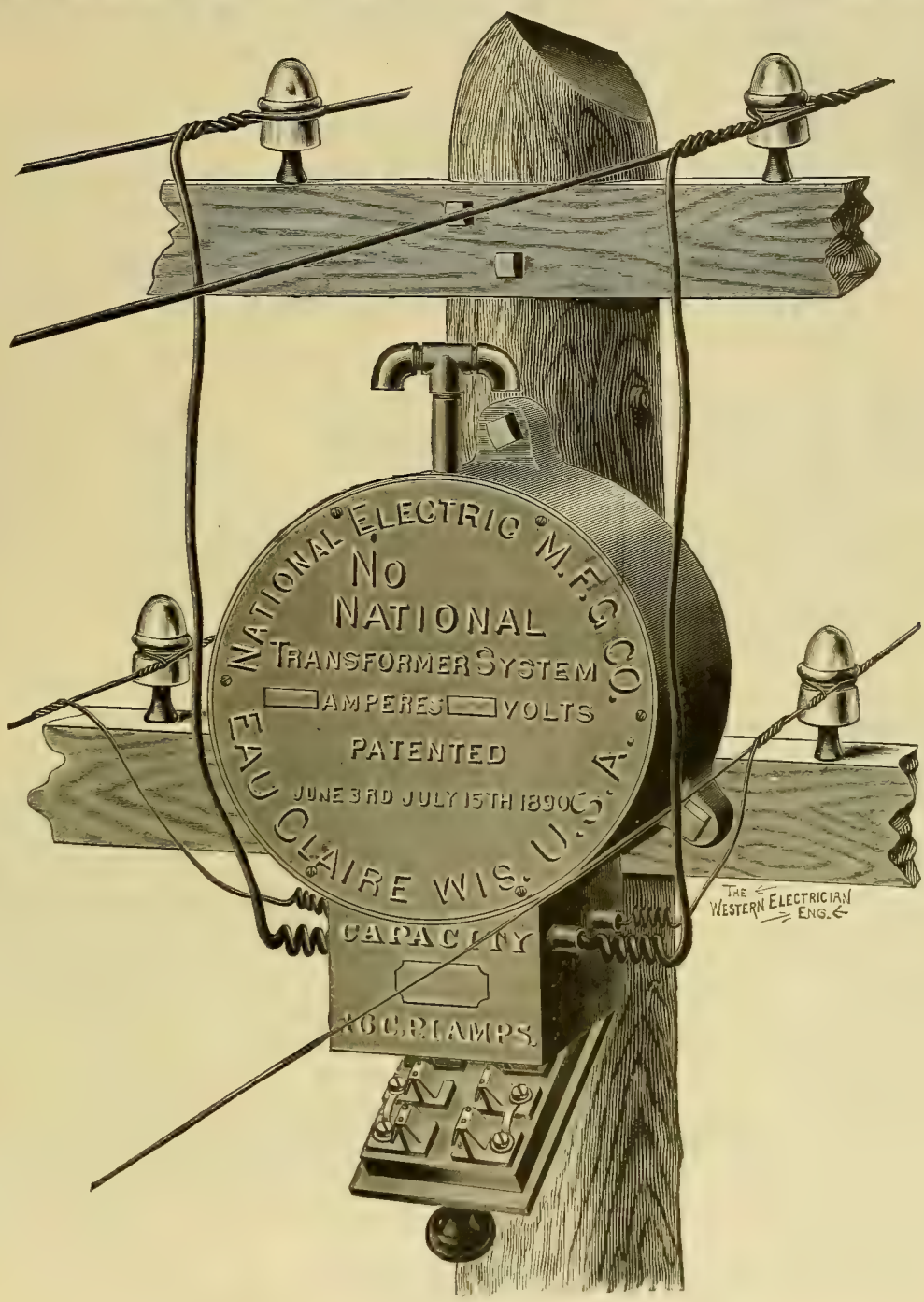

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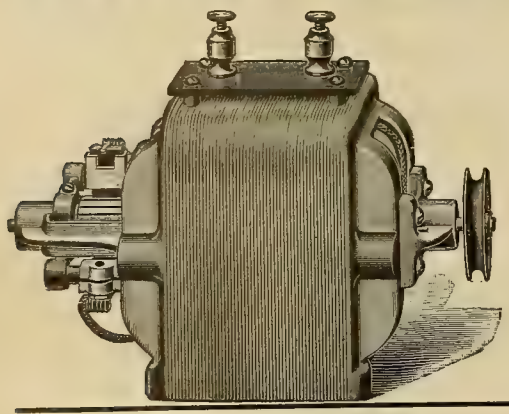

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1st. The words, terms and phrases are invariably followed by a **short, concise definition**, giving the sense in which they are correctly employed.

2d. A general statement then follows of the **Principles of Electrical Science** on which the definition is founded.

3d. When, from the complexity of the apparatus, or from other considerations, it has been thought desirable to do so, an **Illustration or Diagram** of the apparatus is given.

4th. To facilitate study, an elaborate system of **Cross References** has been adopted so that it is as **easy to find the definitions** as the words, and aliases are readily detected and traced.

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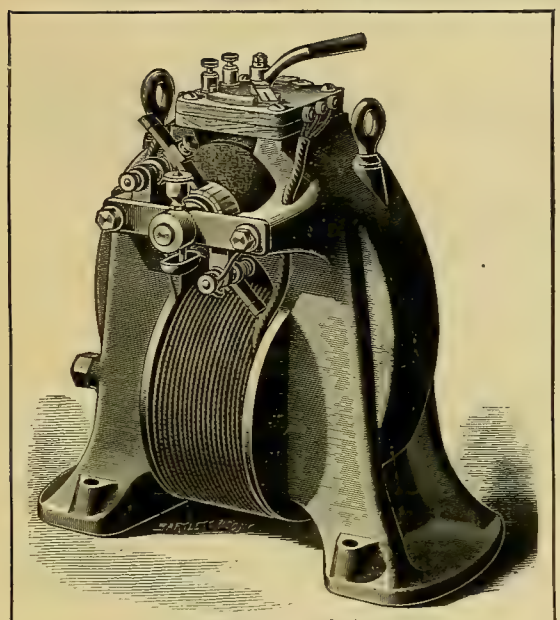

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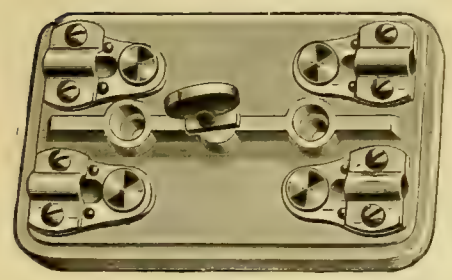

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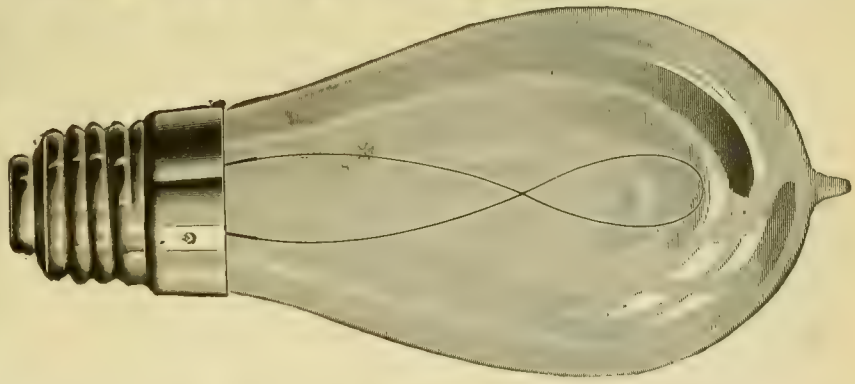

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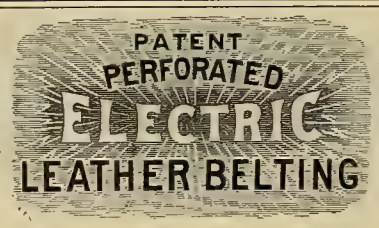

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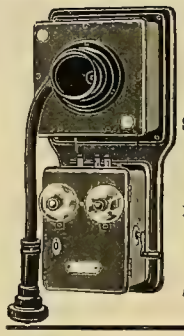

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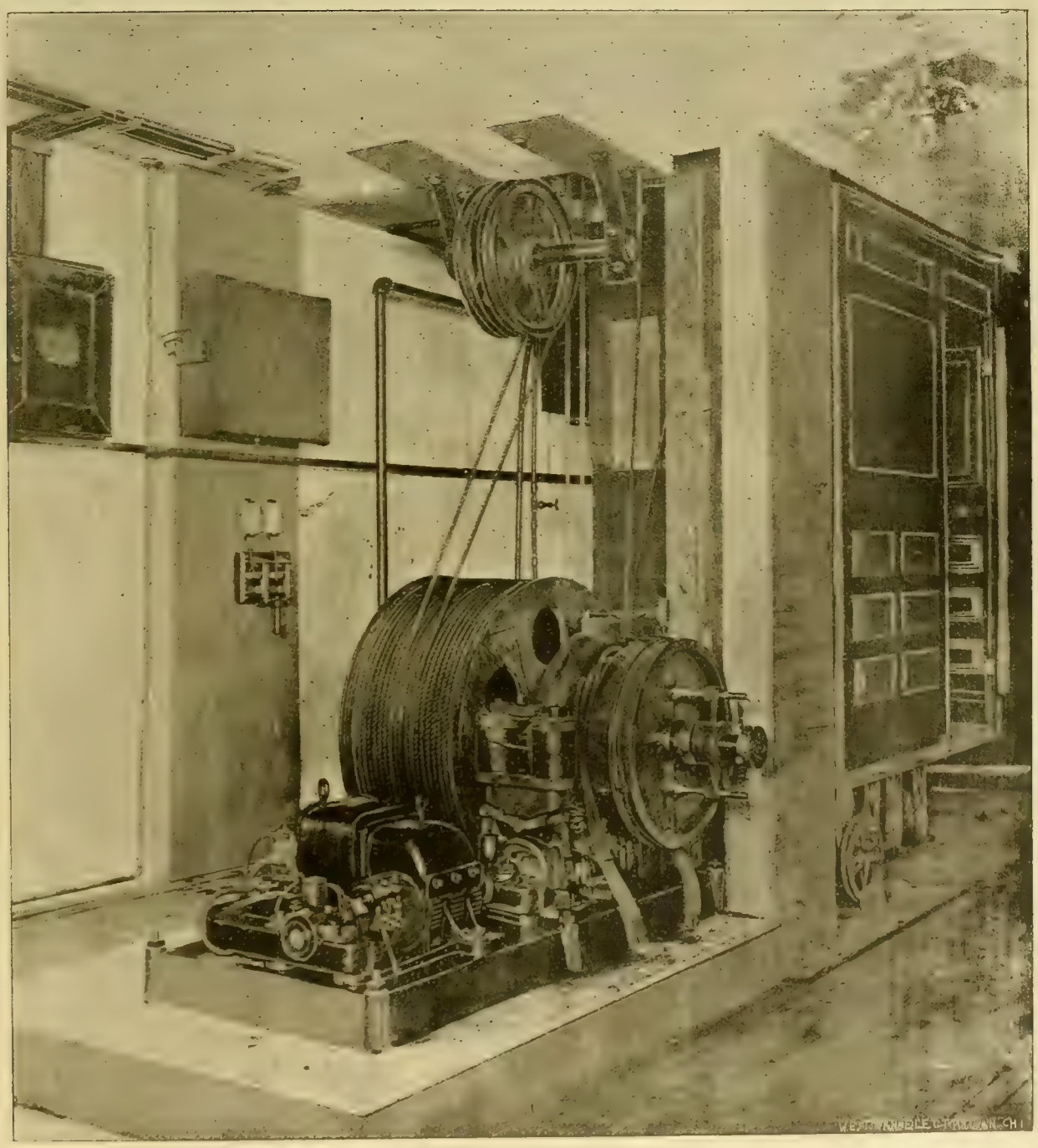
Vol. VIII. CHICAGO, JUNE 20, 1891. No 25

New Thomson-Houston High Speed Elevator Equipment.

The cut presented herewith illustrates a new electric elevator mechanism which is now being introduced by the Thomson-Houston company. This equipment which, it is stated, is the first of its kind to be installed west of New York city, is in service in Kansas City, in W. B. Grimes' office building, 807 Main street. The plant is worked in connection with a passenger elevator, which operates at a maximum speed of 300 feet per minute and carries a load of 1,500 pounds.

As shown in the cut, the machinery is all located in the cellar, although the equipment may be placed just as well in the top story of the building as in the basement. Current is furnished from the system of the Kansas City Edison company.

The outfit consists of a Thomson-Houston ten-horse power 220 volt motor, connected by means of worm gearing with a cable drum. The armature shaft is extended, as shown, and carries a worm which connects with a gear on the drum shaft. The worm runs in oil at a maximum speed of 900 revolutions per minute. Midway between the gearing and the motor there is what is called a "solenoid brake." On the extreme end of the drum shaft there is a pulley over which passes the starting cable. Directly behind this pulley and concentric with it, is a circular case which contains a series of contacts. By means of the pulley and another series of contacts on its inner side, the necessary electrical connections for controlling the machine, are made by the elevator boy's manipulation of the starting cable. For instance, when this pulley is in the position shown, the elevator is at rest at the bottom of the shaft. Supposing that it is desired to have the car ascend, the elevator cable is pulled in the usual manner. This revolves the pulley to the left. The first slight movement acts to



NEW THOMSON HOUSTON HIGH SPEED ELEVATOR EQUIPMENT.

throw the current into the solenoid of the electro-magnetic brake. These magnets being energized, attract the weight shown just beneath them, and the weight, acting through the toggle joint, throws the brake shoes out of contact with the brake pulley on the armature shaft. As the movement of the controlling pulley continues it acts to throw current into the armature through a full resistance which is in a box and is shown in the illustration on the wall next to the meter. The fields of the motor, it may be mentioned, are always kept energized. The further movement of the controlling de-

FIG. 3. SUBMARINE CABLE FACTORY AT CALAIS, FRANCE.

vice serves to cut resistance out of the armature circuit until the motor attains its full speed. The resistance coils used with these elevators are calculated to carry current continuously, so the elevator may be operated at any desired speed without danger of overheating. The resistances are of German silver.

In connection with this rigging there is employed a simple safety device which is shown at the extreme end of the drum shaft. Should the elevator run away and ascend to the top of the shaft, this mechanism acts to prevent any damage by bringing the elevator to a stop. It operates in the following manner: The device is nothing more than a nut on the end of the drum shaft which is threaded as shown. When the drum has made a sufficient number of revolutions to bring the car to the top of the elevator shaft, the drum spindle will have traveled through the nut until the fixed collar on its end has been jammed against the controlling disk and pulled it around. The motion of the disk is, of course, such that all electrical connections are broken and the brake weight left free to act the moment the current is cut off from all parts of the apparatus except the field magnets.

It may be stated here that it has been found advisable, from experience, to have the connections in the machine such that the motor fields will be kept continually energized. Where, however, the service is intermittent or the consumer is economically inclined, by a slight alteration in the wiring, the fields can be thrown in at the same time the brake operates; that is, the fields may be thrown in only when it is desired to use the elevator.

Underneath the drum, and consequently out of sight in the illustration, there is another safety device which might be described as an electric slack cable safety switch. This rigging is an invention of George H. Reynolds, general manager of the American Electric Elevator company, New York. This switch, as its name indicates, is provided as a means of shutting off the current from the motor should the cable slacken enough to jump from the grooves in the drum.

The strictly mechanical portion of this electric elevator equipment was designed under the supervision of the experts of the American Electric Elevator company. The Kansas City plant was fitted up under the personal supervision of Francis L. Stevenson of the engineering department of the Thomson-Houston Electric company, Chicago, Ill.

A similar outfit, it may be mentioned, is being installed by Geo. P. Nichols, in connection with a passenger elevator at Steger's piano salesrooms, Wabash avenue, Chicago.

Submarine Cable Factory at Calais, France.

The accompanying illustrations, reproduced from *L'Electricien* represent a new and large submarine cable factory located at Calais, France. Until this plant was started the French government and private corporations had been mainly dependent on English manufacturers for their cables, and through statistics furnished by the Bureau Internationale de Telegraphie, it was shown that until the year 1889 the quantity of cables furnished by the English amounted to more than 100,000 nautical miles, representing a value of over $200,000,000.

The increasing importance of cable manufacturing has induced French capital to take the necessary steps to secure a proportional share of this industry for that country, and the present plant at Calais bids fair to become one of the largest and most perfect manufactories of the kind in Europe. The ground covered by this plant amounts to 180,000 square feet, and is conveniently located between the Northern railroad track on one side and a branch of the harbor of Calais, called the Carnot basin, on the other, giving an easy and very important access, both to railroad and steamboat.

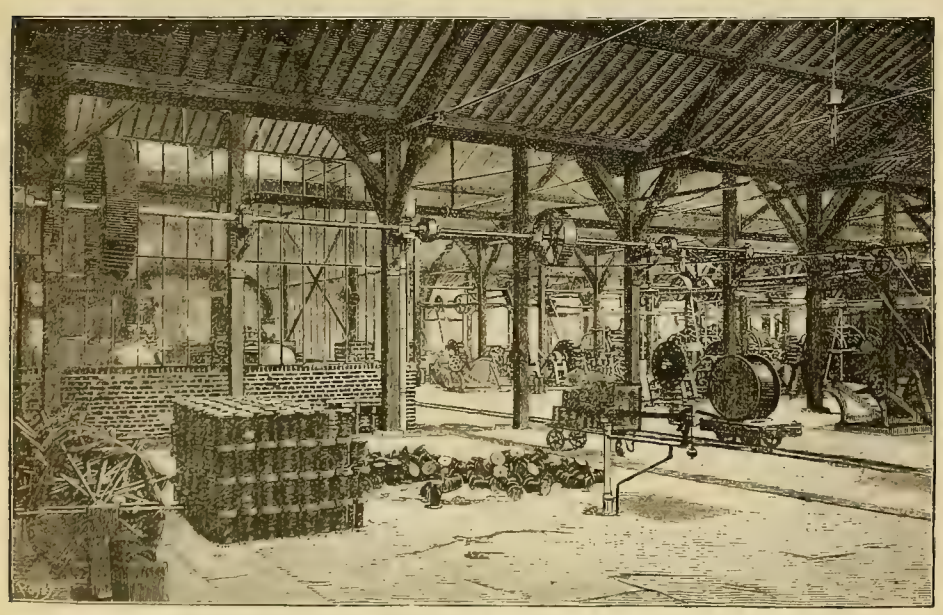


FIG. 2. SUBMARINE CABLE FACTORY AT CALAIS, FRANCE.

The copper wires and stranded cores for the cables made at Calais are furnished by the copper mills at Bezons, and are delivered at the factory on large reels containing on an average three miles of wire. The reels are brought to a large store-room, Fig. 1, where they are placed in cisterns filled with water. Each of these basins can receive 12 reels, and the total storing capacity of the place is 800 miles of bare wire, equal to one month's output. Fig. 2 represents the huge machine hall, which has a floor space of 45,000 square feet, giving place for eight insulating machines. These machines coat the cables with the different layers of insulation, consisting of jute, rubber and different bases of bituminous and silicate composition, and they also wind the outside armor of galvanized iron wire.

The finished cable, after leaving the insulating room, is next sunk into large tanks formed of cement and beton, Fig. 3. These are twelve in number, each having a diameter of 30 feet and capable of containing 250 miles of cable. To facilitate shipments an underground psssage leads direct from the shipping room to the company's docks in the harbor. The capacity

FIG. 1. SUBMARINE CABLE FACTORY AT CALAIS, FRANCE.

of the plant is 25 miles of cable per day, and it gives employment to 300 men, divided into a day and night gang, besides 50 women hands employed during the day in the spooling room. An elaborate testing room is connected with the plant. The insulating machines are furnished with an ingenious contrivance by which any fault in a layer of insulation previously put on is reported electrically to the test room during the progress of manufacturing. This device also automatically stops the machine the moment the fault is detected.

An abstract from the statistics of the International Bureau of Telegraphy, showing the general distribution of submarine cables throughout the world, is of interest in this connection. According to this statement the number of cables in the world is 1,035. The total length of these is 120,069 nautical miles, of which 798 cables, with a mileage of 12,523, belong to the different governments, while 247 cables, or 107,546 miles, are the property of private companies. The distribution between the different nations is as follows:

	Government property		Private property.	
	Number of cables.	Total mileage.	Number of cables.	Total mileage.
United States	.....	.....	22	16,293
France	55	4,068	9	4,389
England	195	3,600	194	80,074
Italy	38	1,027	.....	.....
Germany	43	1,570	.....	.....
Denmark	10	840	22	6,110
Other countries	451	2,063	.....	.....

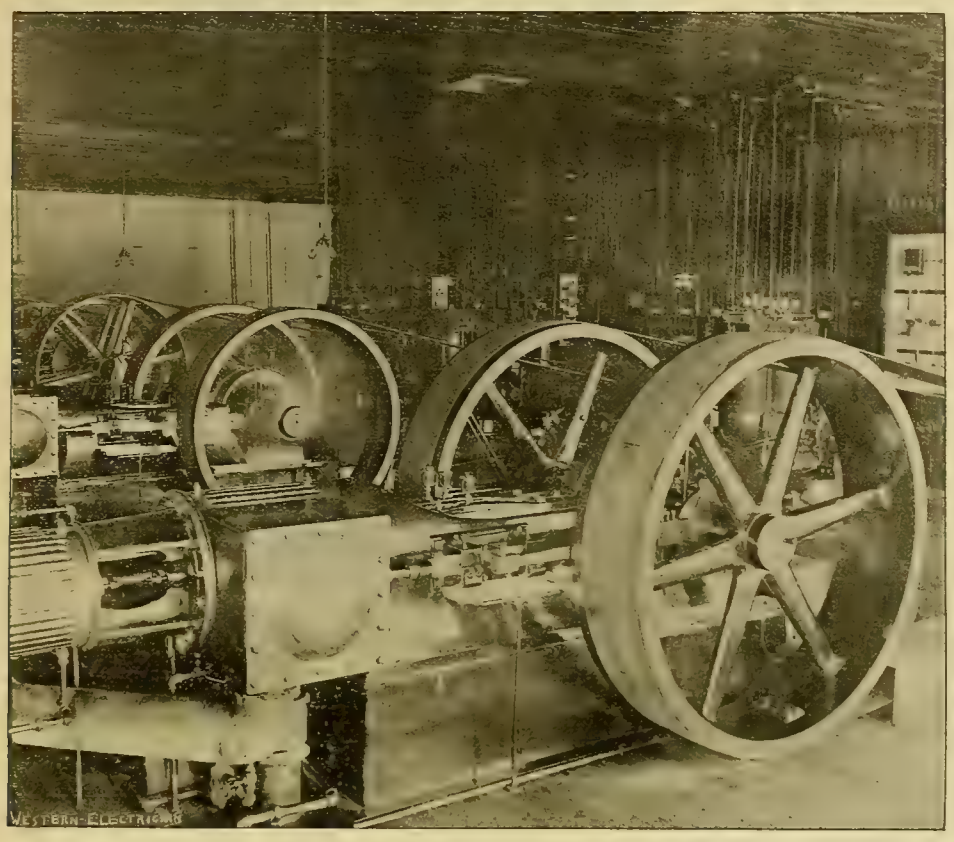
The management of the 247 cables belonging to private concerns is in the hands of 26 companies, of which 5 are in America, 2 in France, 17 in England and 1 in Denmark.

Electricity Substituted for the Cable.

The greater part of the cable line of the Spokane Cable Railway company is now being changed into an electric line. The part being changed is on the north side of the Spokane river, and when completed it will form part of the system now being constructed throughout the city by the Spokane Street Railway company. This system is electric throughout, and when finished it will be one of the most extensive and best equipped in the West. The company owns franchises covering all the principal streets in the city and also all the approaches to the city. Current will be supplied by two Edison 80 kilowatt generators, which are already set up; and sixteen cars will be running by the end of June. These cars are manufactured by the J. G. Brill company, Philadelphia. They are equipped with two fifteen horse power motors each. All the electric lines of the company, radiating in various directions, intersect in the center of the city at the corner of Riverside avenue and Howard street. The cars are painted ivory white with gold trimmings. H. Bolster is president and W. S. Norman manager of the Spokane street and cable railway companies.

Electrical Elgin.

From an electrical standpoint, Elgin, Ill. might be considered a large place. An observing traveler entering the city after dark could not but feel that the people were existing in what might be termed an atmosphere of electricity. On every side there are evidences of prosperity, but one's impressions of the progressive spirit of the citizens are heightened after a personal inspection of things electrical. On every side are to be seen the electric lights; arc lamps on arc circuits and arc lamps on incandescent circuits, in the stores, in the streets, and on towers. Then again, as one is whirled along in the electric cars over the hills and through the residence district, the three white thread-like wires which extend from the poles in the streets through the trees to the half-hidden houses, remind one again that in Elgin as in many other of the smaller western cities, the more modern ideas of convenience and comfort have their hold, and are fully appreciated by the people.



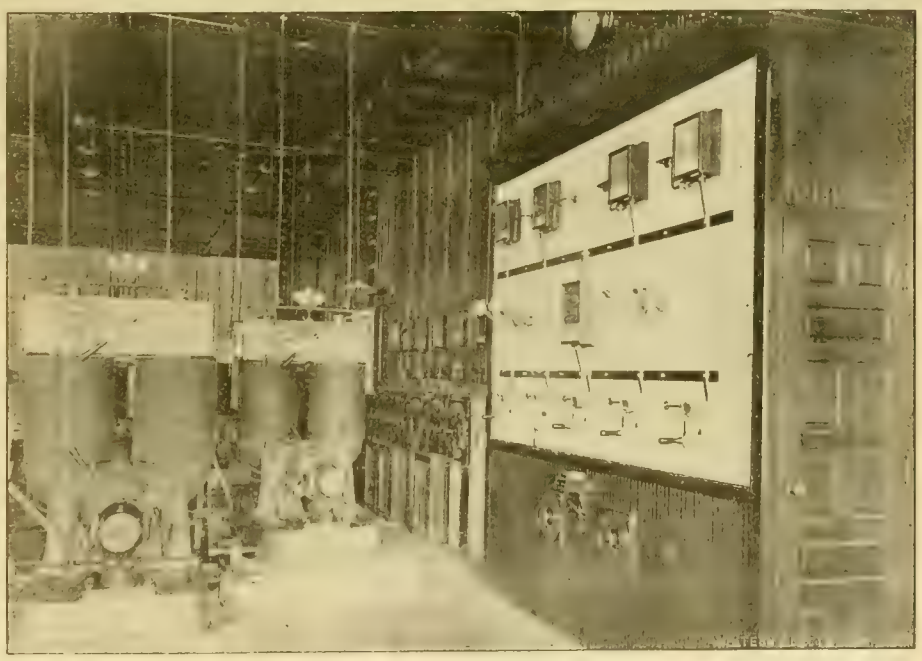
ELECTRICAL ELGIN—STREET RAILWAY POWER PLANT.

ELECTRICAL ELGIN—POWER HOUSE.

The placing of the large Edison plant in the Watch factory gave to Elgin the distinction of having within its limits an isolated station second only in size to the largest in Chicago, and consequently in the west. Three standard Westinghouse automatic engines, developing 200 horse power, and one of 75 horse power, driving directly two No. 20 and two No. 8 Edison machines, constitute the plant. Furnishing as it does current for a system with a capacity of 6,000 16 candle power lamps, and applied to the lighting of only the buildings of the one company, this single installation eclipses many an outfit which is considered as being rightly entitled to the name of "central station."

Besides the Watch factory plant there is the city system and also the power station of the Elgin City Railway company.

The city plant is located in a small square white building on the western bank of the Fox river, which runs through Elgin. Three dynamos, two Van Depoele and one Western Electric driven from a main shaft by a 120-horse power Buckeye engine, supply current to 73 arc lamps, the larger number of which are hung from the towers.



ELECTRICAL ELGIN—STREET RAILWAY POWER PLANT.

Last, but by far the most interesting of Elgin's plants, is that controlled by the street railway company. When the present management decided to adopt the electric system for the cars, it was thought best to consolidate the two plants and remove all the lighting apparatus to the station of the power company. The change was made without shutting off the lights.

The station which was designed, and was constructed in ninety days, by C. Wuestenfeld, who is the company's present manager, covers a ground space of about 125x125 feet. As will be seen from the cuts of its exterior and interior, the station is built according to the most modern engineering practice. Centrally located on the eastern bank of the Fox river, with the tracks of the Northwestern railway close at hand, the position of the plant is such as would warrant the most economical production and distribution of current.

The steam plant proper consists of six 100 horse power tubular boilers built by John Mohr & Son. These supply steam at 95 pounds' pressure, and are equipped with the Sheffield grates. A mixture of Illinois lump coal and screenings is burnt. It may be mentioned here that the station stack is 124 feet high, and has a diameter of six feet. Water for the boilers is drawn from the Fox river, and three of Berryman's feed water heaters are in use.

The engines driving the four 50,000-watt Edison compound wound railway generators, are two 150 horse power Ball of the compound non-condensing type. These generators are run at a pressure of 520 volts in the station.

The plant for the incandescent lighting system is arranged as follows: One 135 horse power high pressure Ide engine drives two 50,000-watt dynamos; one 135 horse-power Armington & Sims high pressure engine drives another set of two 50,000-watt Edison machines; and a small Armington & Sims 80 horse power engine furnishes power for two 25,000-watt machines.

The lighting machines are all plain shunt wound and feed a three-wire system, but the railway generators are compounded.

The arc lighting equipment, placed off in a corner and not shown in the views, consists of one 45-light Van Depoele arc machine and a 50 horse power Armington & Sims engine.

The Elgin Street Railway company operates eleven miles of road. The steepest grade is one of 7 per cent. There are in service 12 cars, each equipped with two 15 horse power Edison motors, and six trailers. The cars are run at a speed of ten to twelve miles per hour.

In the incandescent lighting system six feeders and about ten miles of mains, all strung overhead, are employed. This station supplies about 5,000 lamps distributed over an area with a radius of about 1¼ miles. In addition to the 5,000 incandescent lamps, 52 Universal and ten Mosher arc lamps are attached on the constant potential circuits. Thirty stationary motors of various types, chiefly C. & C. and Edison, in sizes varying from ¼ to 10 horse-power, make

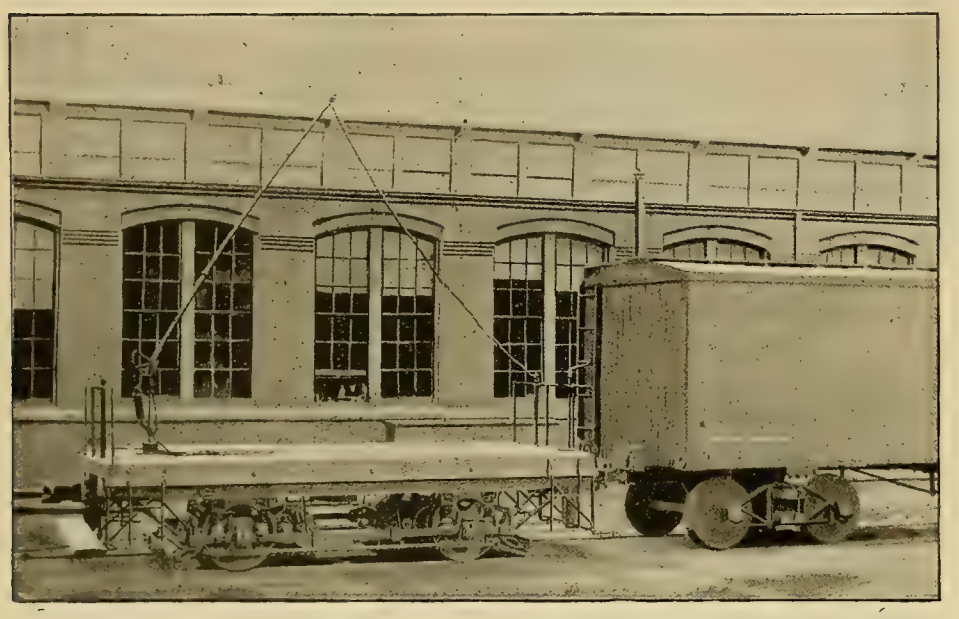
up a power circuit requiring about 50 horse power.

The arc circuit, about three miles in length, supplies 42 Van Depoele lamps.

Electric Freight Car.

The accompanying illustration shows a freight car operated by electricity and intended for use in mills and large manufacturing establishments of all kinds. There are but few large mills that have not sufficient surplus power to operate an electric generator, the current from which, by the aid of electric motors, can be made to do certain classes of work much more satisfactorily and economically than can be accomplished in any other way.

The subject of the cut is one of the largest freight locomotives that has been constructed to be operated by means of electricity. It was built by the Thomson-Houston Motor company of Boston, and is now in use at the cotton mills of the Lonsdale company at Lonsdale, R. I. As can be seen from the illustration, the locomotive consists of a platform car and truck equipped with a thirty horse power Thomson-Houston motor. It is provided with a trolley stand and trolley at one end, and at each end with a controller stand by means of which the speed of the locomotive can be governed and its direction changed when necessary. The locomotive is capable of hauling a load of 60,000 pounds at the rate of five miles an hour. In addition to its use for haulage purposes, the locomotive platform, which measures eight by eighteen feet, may be loaded with material which it is desired to transport from place to place.



ELECTRIC FREIGHT CAR.

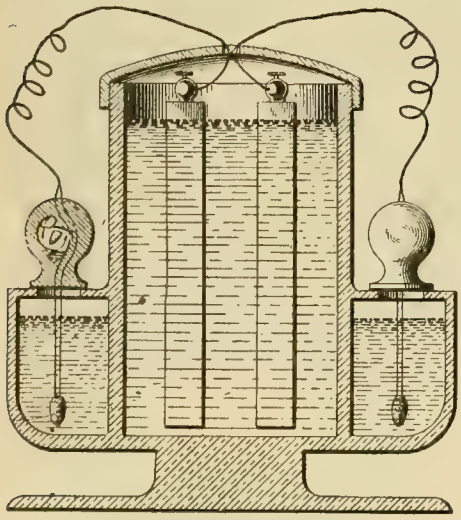


FIG. 1. ELECTRIC CIGAR LIGHTER.

The total length of track over which the locomotive is used is 2,700 feet, on which the single overhead trolley system has been used, the wire being suspended over the center of the track by means of brackets fastened to the buildings, where possible, and to poles. The conductor in between sixteen and eighteen feet from the ground. The necessary current for the operation of this tramway is obtained from a 500 volt Thomson Houston dynamo of 30,000 watts capacity, which is driven from one of the water wheels which furnish power for the mill machinery.

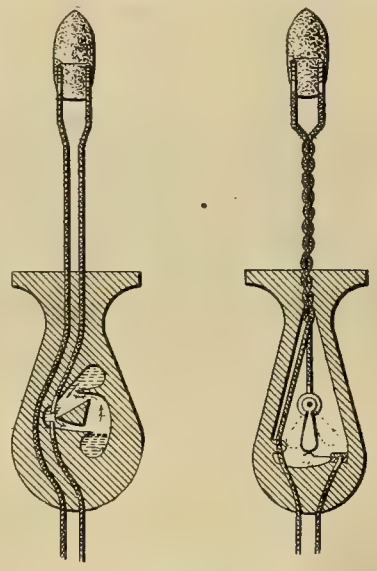


FIG. 2. ELECTRIC CIGAR LIGHTER.

Another Electric Cigar Lighter.

The distinguishing feature of the electrical cigar lighter shown in the cut, is a non-conducting movable handle, provided with a circuit closer so arranged that when the handle is inverted the circuit is momentarily completed and a portion of the external loop of the circuit wires rendered incandescent, so that it may be utilized for cigar lighting.

The preferred contact maker is mercury, which is confined in a chamber of the handle and whenever the handle is inverted, it makes the required contact.

The handle is made of hardened rubber. It will be noted that one of the circuit wires is continuous from the battery down to its termination below the handle. Another parallel wire is divided within the handle, its ends being, however, juxtaposed within the chamber that contains the movable contact maker. This divided wire extends down several inches from the handle and forms a loop, the uninsulated ends being connected by a thin platinum wire, which constitutes an incandescent bridge when the circuit is complete. An absorbent of alcohol, of a non-combustible nature, such as spun glass or asbestos, is applied to and covers the terminals of the wires and the bridge. The chamber of the handle has a peculiar form, it being practically a circuitous passage with a mercury pocket at each upper and lower end. Each pocket is formed in part by a projection or abutment which serves as a deflector for guiding the mercury into the right channel when the handle is inverted from its normal position. When the device is turned over, the mercury leaves the pocket and flows over and around the bared ends of the circuit wire, as shown by dotted lines, on its way to the opposite pocket, and thus momentarily completes the metallic circuit, so that the bridge wire immediately becomes incandescent. This action it is claimed, ignites the alcohol held in the absorber.

To the right in Fig. 2 is shown a mechanical substitute for the mercury body. A metallic piece is pivoted on one of the bared ends of the divided wire within the enlarged chamber of the handle. This piece is so arranged that in swinging from side to side when the handle is inverted, its free end completes the circuit.

H. G. Brown, Washington, D. C., is the inventor of this device.

Important Patent Suit.

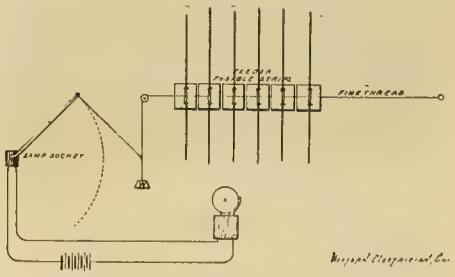
A patent suit, which, if decided for the plaintiff, will apparently invalidate the patents of every company supplying electric motors for operation on car axles, has been begun in St. Louis by the Adams Electric company. The nominal defendant is the Lindell Railway company, but as this company uses the Sprague system the Edison General Electric company will really bear the brunt of the defense. The suit is brought on the ground that the plaintiff s patents have been infringed, in that a patent was issued to Dr. Wellington Adams for the first and only practicable device for attaching electric motors to car axles. This is a sweeping claim and, if substantiated, will prove a very serious matter to the companies supplying electric motors for railway equipment. The Sprague system is singled out for the first attack because its system, it is claimed, was the first to be put in actual use, and thus infringe on Dr. Adams' patent.

The suit will be tried before Judge Thayer of the U. S District court at St. Louis, who is regarded as a high authority on patent law. It is said that there will be an exhibition in court of working models of all the electric railway systems now in operation. The object of this will be to show the alleged infringement made by every system now in use upon the Adams patents.

Signaling the Rupture of a Fusible Strip.

In another column is presented a description of the power plant of the Elgin City Railway company. In this station there is employed an ingenious device for indicating the blowing of the fusible strips in the railway feeders. The arrangement, which is very simple, and is also said to be most effective in its working, is explained for the benefit of those interested in the practical operation of electric roads. A glance at the accompanying diagram will enable the reader to understand the mechanism and its operation with but little explanation.

A fine thread is stretched across, and is in contact with, the railway feeder fuses. These strips, it may be stated, are all in a row on the wall behind the station switch-board. One end of the thread is fixed to a pin, and the other is connected over a pulley to a weight and an arm



SIGNALING THE RUPTURE OF A FUSIBLE STRIP.

fastened, as shown, to the key of an ordinary lamp socket in circuit with a battery and bell. In the position indicated the circuit is broken at the lamp socket. When a fuse blows, the thread parts and the weight falls, thus sending the battery current into the electric gong on the face of the switch-board. This rigging was devised by manager C. Wuestenfeld of the Elgin City Railway company.

Value of Electricity in Agriculture.

French scientists have devoted much attention to the influence of electricity on plant life, generally arriving at the conclusion that it is highly beneficial. As early as 1783 Abbot Bertholon wrote an elaborate treatise "Concerning Electricity in Plants." After announcing the results of his experiments, demonstrating that electricity was favorable to the development of vegetation, this investigator describes two primitive methods of supplying current to growing plants. These devices he styled "electrovegetometers," and one of them is shown in Fig. 1. This consisted of a cart, whose bottom was insulated. A man standing on the bottom of this cart, which was drawn over the field by a horse, held in his hand a watering pot. By means of a conducting wire wound around a bobbin, fixed to the bottom of the cart, the man was capable of putting himself in communication with the poles of an electrical machine, and was thus able to furnish electricity to the plants that he was watering. It does not appear that this simple apparatus, with its human conductor, was ever put into practical operation.

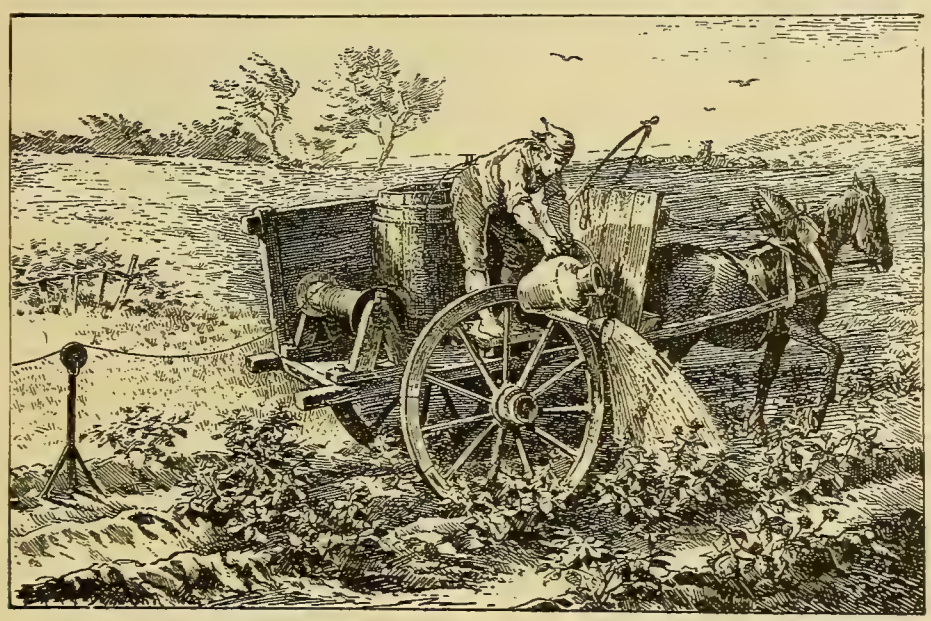


FIG. 1. VALUE OF ELECTRICITY IN AGRICULTURE.

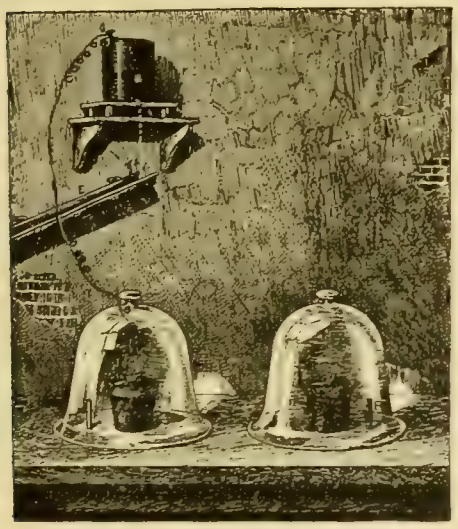


FIG. 2. VALUE OF ELECTRICITY IN AGRICULTURE.

The subject was discussed by many savants at the time, and varying opinions were advanced. A number of experiments were made in the early part of the present century, but later the question was dropped for a number of years. In 1878, however, experiments of much value were made by Grandeau, Leclerc and Celi. The first named showed that atmospheric electricity exerts considerable influence upon the production of vegetable matter. All other things being equal, he said, plants will develop better where they are exposed to the action of atmospheric electricity. If deprived of that, plants will produce from 50 to 70 per cent. less of vegetable material and fruit than plants in ordinary conditions. M. Leclerc arrived at the same conclusion by independent experiments.

The experiment of M. Celi is illustrated in Fig. 2. He took two bell glasses of the same size, and under each of them placed a flower pot, *A A'*. These pots were filled with earth of the same nature, and in each of them he sowed three kernels of Indian corn of the same weight, which he watered with the same quantity of liquid. The air was constantly renewed under the two bell glasses by aspirators, *F F'*. One of the glasses was arranged as follows: An aperture at the top gave passage to a wire that ended within the glass at *P*, in radiating points. Outside of the glass this wire was in communication at *C* with an insulated metallic vessel *B*, placed two meters above the bell glass and filled with water that flowed out through a very fine aperture. Through such flow the vessel became electrified with the same electricity as the air. This electricity was led to the small crown of points, and was thence dispersed in the air which filled the bell glass.

The kernels of corn planted on July 30, 1878, began to germinate on the 1st of August. Three days after germination it could already be seen that the plants under the electrified bell glass were growing faster than the others. On August 10th the height of the plants was as follows: In the electrified air, 17 centimeters; in the non-electrified air, 8 centimeters. The result was therefore favorable to electricity.

Of greatest interest, however, are the more recent experiments of Selim Lemstrom at Brodtorp, in Finland. A system of wires provided with points was stretched over the experimental field. These wires were supported by poles, Fig. 3, and fixed to ebony insulators of an unusual type. The poles were spaced 16 meters apart, and were connected by an iron wire .001 m. in diameter. Over the frame thus constituted, wires .4 mm. in diameter were stretched at intervals of one meter. These wires carried a point at every meter. The electric machines were installed in a shed put up for this purpose and provided with a fireplace, in which there was almost always a fire, in order to maintain a proper degree of dryness. These machines, four in number, were connected by belts with one shaft in common, provided with four pulleys, one for each machine. The whole was actuated by two men through a pulley. The result was a large crop, exceeding, by nearly half, the portions not submitted to electrification. A remarkable circumstance had again confirmed these conclusions. In 1886 the wheat crop was so fine at Brodtorp that it was thought that no better could be expected there, and yet the experimental fields in 1887 gave an excess of 28 per cent. per square meter over 1886. From his various experiments, Selim Lemstrom draws the following conclusions: Plants are divided into two groups. One, the development of which is favored by electricity, comprises wheat, rye, barley, oats, red and white beets, parsnips, potatoes, celeriac, beans, raspberries, strawberries, and leeks. The other whose development is more or less interfered with by electricity, comprises peas, carrots, kohlrabi, rutabagas, turnips, white cabbages, and tobacco. The more fertile the soil, and consequently the more vigorous the vegetation, the greater the excess of the crop under the influence of the electric current.

These experiments were repeated in France in 1888, and the results were the same. The success of these interesting experiments has led to the hope that the discovery may yet prove of practical value in market gardening and hothouse culture.

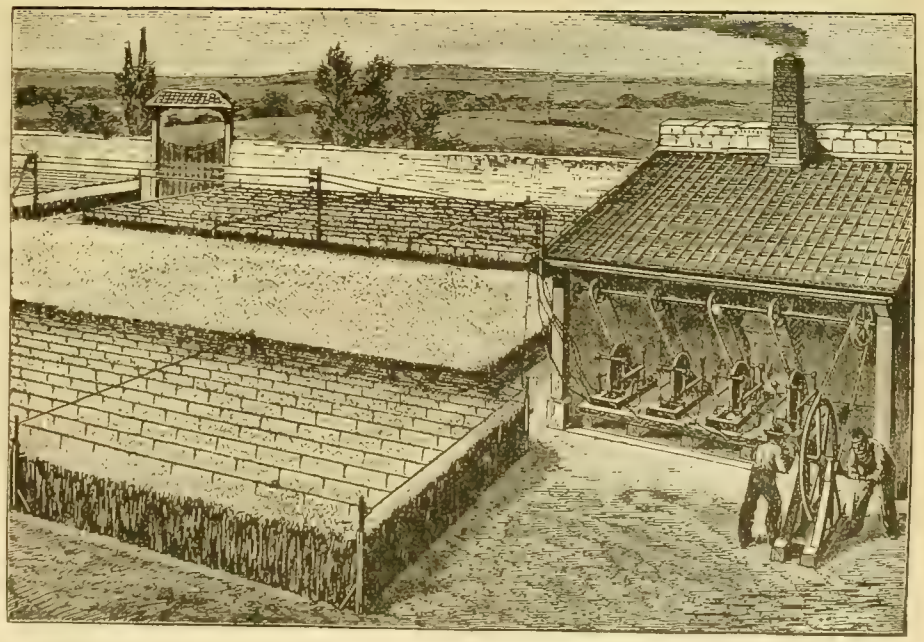


FIG. 3. VALUE OF ELECTRICITY IN AGRICULTURE.

The statements in this article and the accompanying illustrations were taken from a paper by H. Farjas in *Les Inventions Nouvelles.*

The big chimney of the Narragansett Electric Light company's station at Providence, which has just been put into use, has excited much attention among civil engineers on account of its dimensions. It is about 270 feet high, and 1,332,921 brick and 3,858 casks of sand were used in its construction.

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F. L. PERRY, - - - - - - - - - - - }
W. E. KEILY, - - - - - - - - - - }
J. L. BAKER, - - - - - - - - - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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ONCE more the superiority of the electric system of street railways has been recognized, this time at Spokane where electricity has been substituted for the cable.

THE customs returns show a gratifying increase in the amount of electrical exports. During April and May the value of such exports was one-third greater than for the corresponding period last year. There is no reason why this growth should not continue until electrical goods occupy a conspicuous place among American exports.

THE people of San Francisco, according to our correspondent, have not yet learned that electric cars can be operated with safety by means of the overhead system. If, instead of placing obstructions in the way of street railway companies, city officials would encourage the application of new methods, they would greatly advance the development of rapid transit.

AN electric railway between Rochester, N. Y., and Lockport is projected and it is claimed it will be the longest line in the world. There will be sixty miles of road and it will be utilized for freight as well as passenger service. As the road will pass through one of the finest farming sections in the country and connect several thriving villages, it is anticipated that it will be highly successful.

THE daily newspapers announce that the Anaconda copper mines of Butte, Mont., have been sold to a Rothschild syndicate for a consideration supposed to be between $20,000,000 and $25,000,000, the exact figures not being given. It is not thought, however, that this transfer will materially affect the price of copper. At any rate, the quotations for copper for electrical uses can only be contingently affected, as Montana copper is not used for this purpose.

THE action of the attorneys who have been conducting the defense of the prisoners convicted of murder in New York has been severely criticised by the Court of Appeals. When the claim that the act was unconstitutional was first presented it was considered by the state courts and later by the Supreme Court of the United States. Despite the rulings of all the courts the lawyers intrusted kept up the fight, raising technical objections and succeeding in delaying the execution of the sentence of death.

ATTENTION is called to the important announcement on another page in relation to the annual meeting of the National Electric Light association in Montreal. The convention will be held on the 8th, 9th and 10th of September, while the attendant exhibition will be open from the 7th to the 16th of the same month. These are dates that should not be forgotten. The Montreal people, it is evident, are co-operating with the officers of the association with the greatest cordiality, and there is not the slightest doubt that the gathering will be both pleasant and profitable in the highest degree.

IN the discussion of Prof. C. S. Cook's paper on the "Present Theories Concerning the Nature of Electricity," read at the last meeting of the Chicago Electric club, Thos. D. Lockwood related an interesting account of a peculiar effect of a lightning stroke on a telephone wire. It seems that the lightning struck a building, breaking away the plaster where the wire entered and passed through a great many feet of the wire, which was cotton covered. When the wire was examined it was found that, practically speaking, nothing was left but the cotton cover. This, however, was intact and apparently in as good condition as when first strung. The only traces of the wire proper which could be discovered were some fine copper particles clinging in the meshes of the cotton insulation. The phenomenon was discussed by the club and a theory was advanced in explanation of the singular effect. The stenographic report of the discussion and a photographic reproduction of the remnant of the wire are presented in another column.

THE subject of ventilating underground electric conduits in Chicago to prevent man-hole explosions has been taken up by the city council and a report has been presented on the question by City Electrician Barrett. It is believed that the city should exercise its police powers and cause the conduits to be ventilated. There is no question that the city has the right to do this as a measure for the protection of life and property. Moreover, there seems to be little doubt that the city is liable for damages when accidents of this kind occur. The last explosion that took place was the most serious in the history of electric lighting in Chicago. It will be remembered that one person was killed and considerable property was destroyed. The primary cause of all these explosions may be readily traced to the gas companies, which have so poorly constructed the gas mains that a large portion of the product of the works is allowed to escape and find its way into the sewers and conduits. It would appear that the city should take steps to compel the gas companies to reconstruct their mains in such a manner that they will not be a constant source of danger to the life and health of the residents of the city. Those who are engaged in electrical enterprises cannot but wonder at the attitude of city officials toward gas companies when they remember the crusade that has been waged on electric wires. If one-half of the care were exercised by the gas companies in operating their plants that is given the construction of electric conductors there would be little reason to complain of the presence of danger from illuminating gas in residences and commercial buildings, and there would be no man-hole explosions.

A FAVORITE argument advanced by the advocates of governmental control of private enterprises is that under the proposed arrangement the taxpayers would secure the advantages and pecuniary gain which are now enjoyed by stockholders in the large corporations it is intended to supplant. This would be accomplished, according to the projectors of the scheme, by furnishing taxpayers light, heat, power, etc., at cost of production. These gentlemen announce that there will be no high salaried officers, no dividends, and in fact everything would be conducted with the single object of supplying the public the best possible service at a minimum cost.

No doubt the intentions of the gentlemen advocating these changes are good, but the lack of practical experience which they display is certainly wonderful. The WESTERN ELECTRICIAN has repeatedly called attention to the fact that in all arrangements of this kind the people would be called upon to support a lot of worthless employes, whose only claim to recognition would be their "political pull." At the beginning of operations there would be no doubt an attempt made to keep the political bosses from interfering with the operations of the department, but as soon as the system began to develop and employ a large number of hands, its advantages politically would be apparent and the "leaders" of the party in power would endeavor to control it.

These who have watched the proceedings in the Chicago City council during the last few weeks will realize the force of these remarks. The city council has been considering the question of manhole explosions, and this has given the city fathers an opportunity to pave the way for a raid on the city treasury. At present they demand only the appointment of an "Inspector." He will no doubt soon learn that assistants are needed and as the Chicago *Tribune* aptly remarks, he will want his office turned into a "bureau" and finally it will develop into a "department" and the "commissioner" or head of this department will find all his time occupied in supporting the dignity of the office. The conduits will then be turned over to political bummers.

Thus far the city electric system has been fortunate in having at its head a man who realizes the necessity of keeping the office out of politics. He may succeed in keeping it under the same system but it is to be feared that before the department gains much more importance it will be invaded by the same political influence that permeates all other departments of the city government. When this is done the taxpayers will wish themselves well rid of the municipal system which is now so popular with the followers of Bellamy and other advocates of socialistic theories. The experience thus far attained in conducting as public works, enterprises which properly should be controlled by private capital, has not been such as to give confidence in such projects.

Open competition among live corporations will insure far superior service to that under a time-serving political management.

Underground System in Paris.

A description of the method of distribution at the great central station at Rue de Dames des Batignolles, Paris, was given in the WESTERN ELECTRICIAN May 30th. In the accompanying cuts is illustrated the underground system adopted by this station. The system in service is the Siemens single conduit, employing cables insulated as shown in Fig. 1, which represents a full size sectional view of one of the main cables,

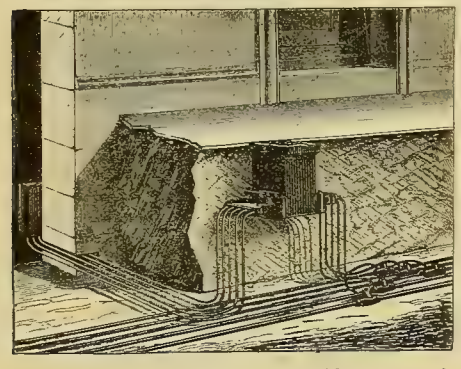


FIG. 3. UNDERGROUND SYSTEM IN PARIS.

having a sectional area of 1,292,315 circular mils and a weight of 22¾ tons per mile. The core of the cable consists of 38 copper wires, each of which is equal in conductivity to No. 5 B. & S. gauge. These are insulated with a 1-8 inch wrapping of jute impregnated with asphaltum and surrounded by a 5-64 inch lead casing. Over this again is wrapped a coating of hemp soaked in a bituminous compound and enveloped in a double sheathing of steel bands of which one layer covers the joints of the other. Finally the cable has upon it a coat of asphaltum paint to prevent corrosion of the steel. One of the wires of the cable, having a smaller sectional area and an individual insulation, is utilized as a pressure wire for indicating at the station the drop of potential at the terminals of the cables. Fig. 2 represents part of a conduit for the distributing main. These latter are formed on the same principle as the large cables. The conduit consists of a square ditch under the sidewalk. First, a foot of dry sand is placed in this ditch and on this the cables are laid. At frequent intervals a tap-wire extends from the joints of the cables to junction boxes in manholes, entrances to which are on a level with the sidewalk. From these manholes a number of

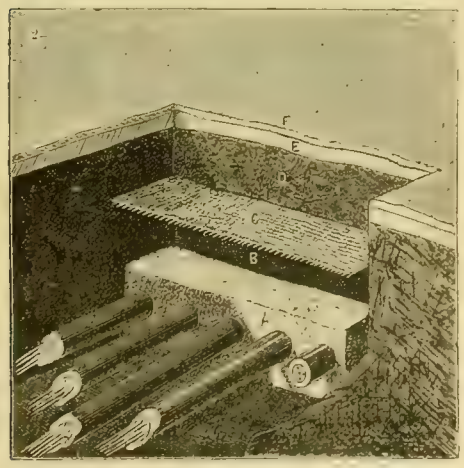
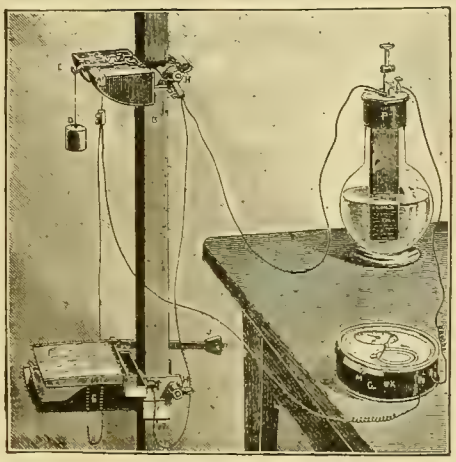


FIG. 2. UNDERGROUND SYSTEM IN PARIS.

service wires up to five are carried into the buildings, Fig. 3; that is, two, three, four or five wires are run in according to the number of lights employed and the degree of equalization required. After the necessary joints and taps on the cables have been made, another layer of dry sand is thrown into the ditch covering the cables entirely. Over this is placed a galvanized iron netting to separate the sand from a layer of concrete, which is next introduced. Over the concrete is spread cement, and finally asphaltum, which forms the surface of the sidewalks in Paris.

The consumption of electrical energy by the subscribers is measured by a special form of Aron meter. In this meter four coils or bobbins, one connected in each of the four outside service wires, have a joint action on a polarized armature in such a way that the product of the current in amperes, passing through all the wires, forms the base of action upon the indicator. To explain this without another diagram it may be presumed that each lamp consumes one ampere of current, and that the number of lamps in service, as represented in Fig. 4, is 7, divided as follows: Four lamps in the first section, none in the second section, two in the third, and one only in the fourth section. Wire No. 1 will then be traversed by a current of, so to speak, +4 amperes; No. 2 by —4 amperes; No. 3 by +2 amperes and No. 4 and 5 by—1 ampere each. The bobbins of the meter are wound in the following way: No. 1 and 5 bobbins, joined on their respective wires, are wound with an equal number of ampere-turns. No. 2 and 4 have only half as many turns, the No. 3 wire being passed straight through without having any influence on the meter. The action of the spools on the polarized armature is in accordance with the direction of the current passed through them, resulting in an attraction and repulsion of the armature. Taking the relative value of the outside spools or bobbins to be 2, the inside spools will then be 1, and the summing up of



MEASURING THE VELOCITY OF FALLING BODIES BY ELECTRICITY.

the current flowing in the five wires will prove to be:

Wire 1	$+4\times2=+8$
" 2	$-4\times1=-4$
" 3	$+2\times0=0$
" 4	$-(-1)\times1=+1$
" 5	$-(-1)\times2=+2$
Total	$+7$

The table shows a balance of +7 amperes, which is the product of the attraction on the armature, recorded on the meter scale through a common rotating velocimeter. The cuts are reproduced from *La Nature.*

Measuring the Velocity of Falling Bodies by Electricity.

In the accompanying illustration, taken from *Les Inventions Nouvelles*, is shown an electrically operated chronometer, by which, it is claimed, so minute a fraction of time as the one-thousandth part of a second can be measured. As indicated, the apparatus is made use of to determine the length of time consumed by a body falling a previously ascertained distance. Knowing the distance and the time, the velocity can of course be easily calculated.

The principle of the mechanical portion of the apparatus is based upon the use of a chronometer balance beating the fifths of a second, a special mechanism causing the balance to describe each time a complete angle of 360 degrees. If a hand be fixed to the axis of such a balance, it will be seen that this hand will, five times per second, describe an entire circle, now in one direction and now in the other, and that if this circle is divided into 200 parts, each of these divisions will correspond to a thousandth of a second. The first difficulty was found in the graduation of this circle. As at every movement of the balance the velocity starts from zero to return thereto, passing through a maximum, it results that the space traversed at every instant is not the same for the same duration of time. This fact had to be taken into consideration in the graduation of the dial, on which the divisions have, therefore, to be closer at the beginning than at the middle of the travel. As the hand turns now in one direction and now in the other, it is necessary to know the direction of the motion at the moment that

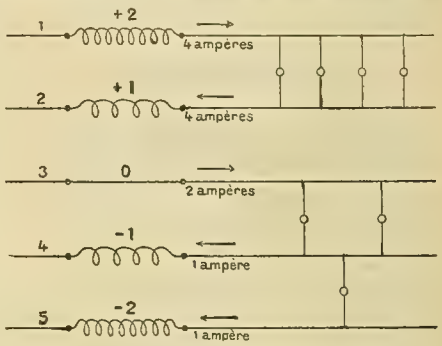


FIG 4. UNDERGROUND SYSTEM IN PARIS.

the latter is arrested in order to know in what direction the reading must be made—the divisions from zero to 200 being marked in the two directions for the sake of facility in reading. To effect this a small hand on the left of the dial indicates, when it is down, that the reading is to be made from right to left, and from left to right when it is up.

An electro-magnet acting almost directly upon the balance serves to set in motion or stop the mechanism instantaneously. Two small terminals, *L* and *L*¹, as shown in the cut, receive the wires coming from the battery. A button, *K*, serves for stopping the mechanism by hand, in experiments that do not require very great precision. Finally a bolt, *M*, serves to bring the thousandth hand to zero, and with a half turn sets the spiral in such a way as to permit the balance to move instantaneously at the moment the current is broken.

The application of the chronometer to the determination of the fall of a weight, *D*, descending from a stage, *A*, upon a stage, *G*, is shown in the illustration. These two stages are connected with the circuit of a battery whose current passes through the electro-magnet of the chronometer. The motion being arrested and the index brought back to zero by

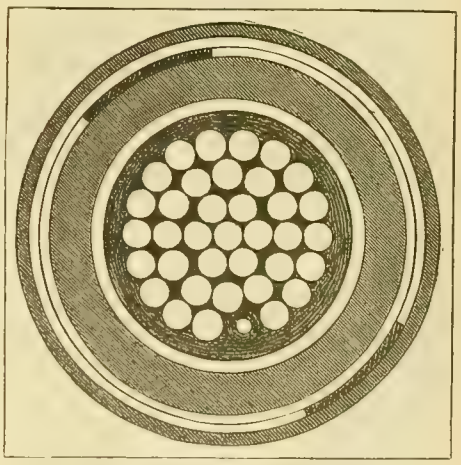


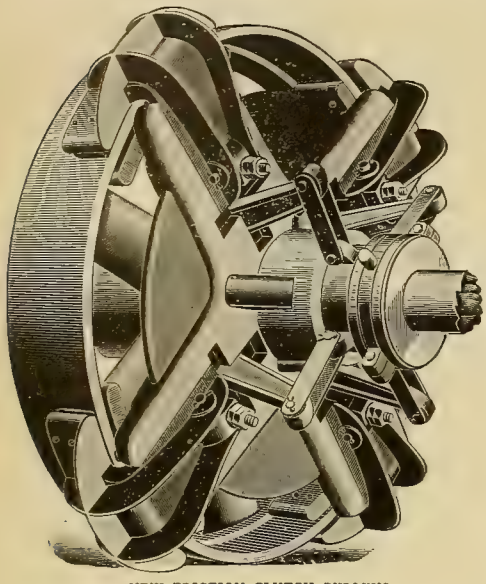
FIG 1. UNDERGROUND SYSTEM IN PARIS.

turning the bolt, the division at which the fifth of a second hand has stopped is noted. If now the thread that holds the weight upon the tongue, *E*, is broken, the latter will rise under the action of a spring, *e*, the circuit will be broken, and the chronometer will be set in motion. When the weight striks the plate, *F*, (kept horizontal by the counterpoise, *J*, placed at the extremity of the rod, *I*), the latter will incline, and, touching the edge of the piece, *G* (from which it is not far distant in a normal state), will re-establish the current, and the mechanism of the chronometer will be instantly stopped. The two stages, *A* and *G*, are capable of sliding along a graduated upright, *B*, against which they are held by adjusting

screws, *H*, thus permitting of varying the height of fall by degrees as small as it may be desired to demonstrate the sensitiveness of the apparatus.

New Friction Clutch Pulleys.

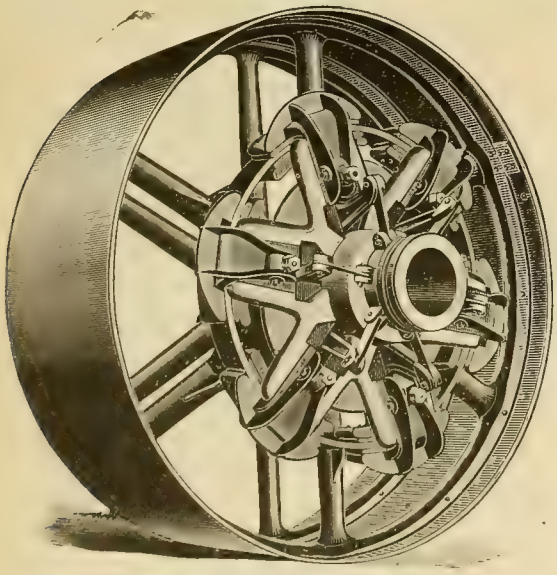
The new friction clutches and patent steel rim pulleys, shown in the accompanying illustrations, are especially adapted to electrical work. They are manufactured by the Falls Rivet & Machine company of Cuyahoga Falls,



NEW FRICTION CLUTCH PULLEYS

O. A special advantage is claimed in the fact that the pulley faces are of rolled steel, instead of cast-iron, strengthened and stiffened by cast-iron rims connecting the outer ends of the pulley arms. This, it is claimed, makes these pulleys from 25 to 40 per cent. lighter than corresponding sizes of cast-iron, while the strength and power transmitting quality are increased.

The clutch, as shown in the cuts, is keyed to the shaft, but the pulley is not. Therefore, when not "in clutch," a driving pulley remains motionless while the shaft revolves freely in the babbited pulley sleeve. Immediately upon being thrown in clutch the power is trans-



NEW FRICTION CLUTCH PULLEYS.

mitted to the pulley through the medium of the clutch arms, jaws and ring. When the clutch is attached to the driven pulley, located on machine or countershaft, the pulley revolves freely upon the shaft until the clutch engages with it and causes it to drive the shaft. When desired, the power can be applied by degrees. The cut-off couplings permit the instantaneous stopping of that portion of the line shaft which lies beyond the friction clutch.

An electric road will probably be built at Bonham, Tex.

New Buckeye Lamp.

The Buckeye Electric company of Cleveland will shortly commence the manufacture on a large scale of a new incandescent lamp, which has recently been perfected. The filament used possesess such a high degree of elasticity that it is possible to take the one in ordinary use and draw it out to a perfectly straight line and when released it will resume its normal position. From this carbon the company manufactures a lamp for high voltage circuits in which it guarantees that the filament will not droop against the bulb. The filament, as shown in the accompanying illustration, is wound in a broad curl, thereby strengthening it, and shortening the lamp from the base.

At present the company is largely engaged in the manufacture of series lamps for arc circuits.

Preparations for the Montreal Convention.

Extended accounts in the local papers of the meeting executive and exhibition committees of the National Electric Light association in Montreal last week prove the interest taken in the subject. Among those in attendance were J. J. Gulick, New York; C. R. Huntley, Buffalo; F. R. Redpath, Prof. Bovey, Prof. Cox, of the M. D. Barr of the Edison company, Toronto; W. J. Morrison, Fort Wayne Electric company; Fred Nichols, Toronto; H. H. Fairbanks, Worcester, Mass.; E. F. Peck, Brooklyn, N. Y.; J. W. Beane, secretary-treasurer N. E. L. association; S. C. Stevenson, A. J. Corriveau and Jno. Carroll of Montreal.

The visitors were cordially welcomed by the mayor of the city and other representatives of the city government, as well as by the citizens' committee. His honor assured the Americans that he would be very glad to welcome them and their associates at the time of the convention. Other speeches were made by Alderman Stevenson, ex-Mayor Beaugrand, representing the French-Canadian population, and President Huntley of the association. Professor Bovey read a communication from Lord Stanley saying that the latter would in all probability attend the annual meeting in September.

The visitors were driven about the city, visiting McGill University, Mr. Beaugrand's residence, the city hall, the City club and Mont Royal. On Monday evening they were tendered a dinner at the Windsor hotel, at which many speeches were made evincing the cordiality existing between the hosts and guests.

On Tuesday considerable important business was transacted. It was decided to have the exhibition open from September 7th to 16th inclusive, at the Victoria rink, which has been secured on account of its size. In speaking of the coming exhibits the Montreal *Herald* says:

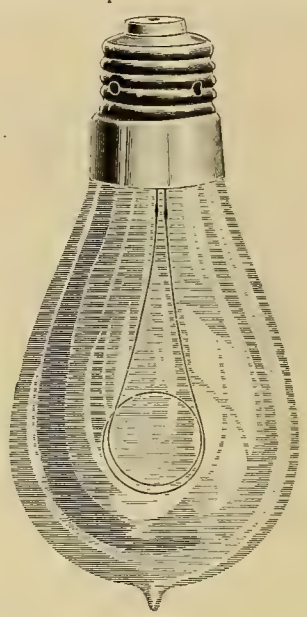
"It is expected that this coming exhibition will be undoubtedly the most interesting, as also the largest, held yet in the interests of electricity in America, if anything can be judged from the enthusiasm shown by the electrical fraternity and also by all the largest electrical companies, which have already applied for much space. From the applications for space already made it is believed that if the Victoria skating rink were doubled in size it could be well filled. It is proposed, in anticipation of insufficient space, to erect a large tent on the vacant ground adjoining the rink, which has been kindly offered to the committee by S. C. Stevenson for the purpose. A working sub-committee was appointed for the different arrangements in connection with the exhibition, composed of F. R. Redpath, chairman; J. J. Gulick, Prof. Bovey, Prof. Cox, Fred Nicholls, S. C. Stevenson, A. J. Corriveau and John Carroll."

The date of the convention was definitely fixed for September 8th, 9th and 10th.

A special committee has been appointed to give information regarding the arrangements. The following named gentlemen compose the committee: Geo. F. Porter, Philadelphia; R. D. McGonnigle, Pittsburg; W. A. Kreidler, Chicago; E. R. Weeks, Kansas City; E. R. Gilman, Chicago; J. J. Ayer, St. Louis; R. F. Ross, Boston.

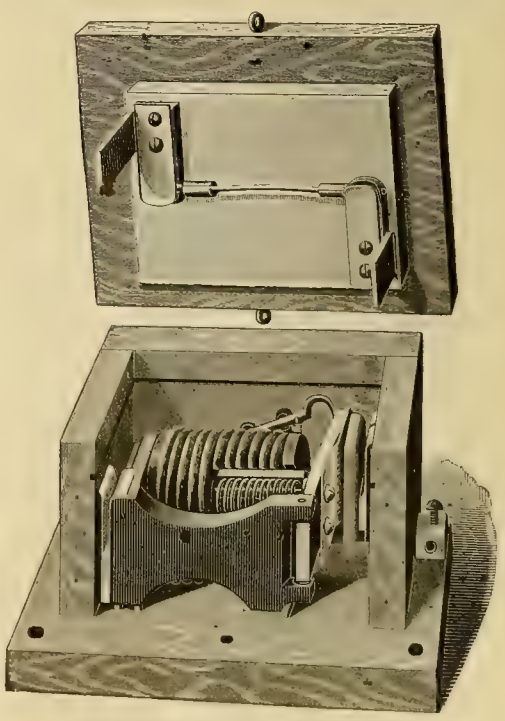
Magnetic Cut-out for Railways.

The burning out of armatures and field coils in railway motors is the source of much annoyance and great expense, so that there is quite a demand for a reliable safety device which will open the circuit when the current exceeds a certain amount. A simple fuse alone can not always



NEW BUCKEYE LAMP.

be relied on, and it is therefore safer to depend upon a magnet which will act with a specified amount of current. By combining a magnet and a fuse a most desirable cut-out is secured. The cut illustrates a device of this pattern, designed by W. E. Harrington, and placed on the market by George Cutter of Chicago. As the cut shows, a properly proportioned magnet is placed in shunt with a fuse which can carry but a small part of the maximum safe current. The resistance of the magnet being low, the fuse is practically shunted out until the current



MAGNETIC CUT-OUT FOR RAILWAYS.

through the magnet becomes too great. Then the armature is drawn up and the whole current is sent through the small fuse, which is sure to blow. A spring catch holds the armature, until the fuse is replaced, which can be quickly done without the use of tools.

The magnet is protected from the molten metal by a thick sheet of asbestos, and all parts are made of ample size. The device is well built and has been applied successfully in everyday practice.

The Griscom Secondary Battery.

In the storage cell shown in the accompanying cut, which is the invention of W. W. Griscom, Haverford College, Pa., the elements *J* and *K* are in the form of masses of dough or paste, the positive portion being a mixture of dilute sulphuric acid and peroxide of lead and the negative part being composed of dilute sulphuric acid and spongy lead. The positive and negative material is substantially the same as is formed upon the positive and negative plates of

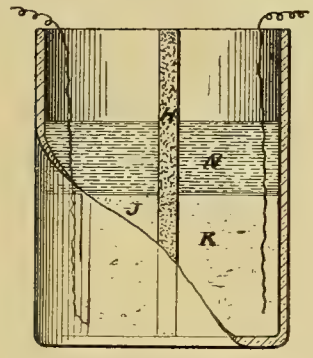


FIG. 2. GRISCOM SECONDARY BATTERY.

a lead battery by the Plante method of forming.

Referring to the cut, Fig. 1, it will be seen that the cell proper is spherical in shape. The walls *A* of this inclosing chamber are lined with lead *L* to prevent the acid attacking them and its interior is divided by a porous diaphragm *H* of insulating material. The masses constituting the elements of the battery are covered with an electrolyte *N* composed of dilute sulphuric acid and charged by the passage of a current until polarized. Mr. Griscom explains the action of the battery substantially as follows:

Up to a certain point the process of charging is similar to that in common use, and the elements may be used as well in an open as in a closed vessel, Fig. 2. When, however, oxygen and hydrogen are given off from the respective masses, the process of charging necessarily terminates, since the further passage of current through the battery would not increase the polarization of the elements and would by electrolytic action decompose and consume the liquid covering the elements. The action of the gases, oxygen and hydrogen upon the respective elements of a secondary battery polarizes them and places them in the condition in which they are ready to give forth an electric current. It follows from this, that by supplying oxygen to the positive plate and hydrogen to the negative plate the process of polarization will continue as long as the gases are furnished.

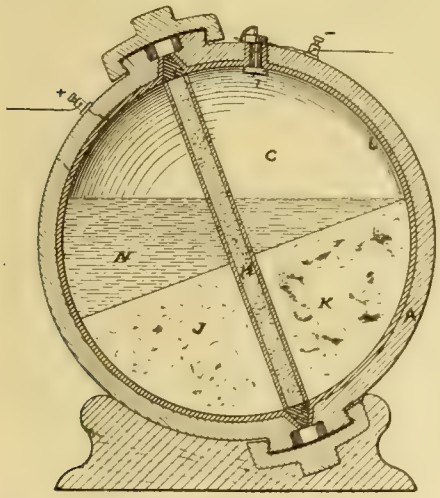


FIG. 1. GRISCOM SECONDARY BATTERY.

A current, therefore, may be taken from the elements so long as oxygen and hydrogen exist in proximity to them. It was to attain this further effect that the positive and negative elements are inclosed in the very strong receptacle *A* divided by the insulating porous partition *H* on each side of which one of the active masses is placed. A quantity of dilute sulphuric acid is added, sufficient to cover the masses of active material, and the air space *C* above the normal level of the electrolyte must be larger on the negative than on the positive side in order to preserve the ratio between and prevent mixing of the gases produced by decomposition of the water in the electrolyte. The allowance is twice as much space for the hydrogen as for the oxygen. The space is obtained by tilting the cell as indicated. The operation of charging as ordinarily understood having been completed, the supply of current is continued until any desired portion of the entire quantity of fluid in the battery has been separated into the gases hydrogen and oxygen, the oxygen remaining on the positive side of the diaphragm and the hydrogen on the negative side. The evolution of great quantities of gas of course produces an enormous tension within the closed chamber. When the electrolyte has been entirely decomposed, the battery is operative as a simple gas battery, it being well known that the action of the gases oxygen and hydrogen separately upon suitable electrodes will produce a current. This action continues until, by their action upon the electrodes, the gases recombine and form again into water, replacing the electrolyte. When the discharge of the gas-battery is completed, the electrolyte will be again in position and the discharge will continue as from an ordinary secondary battery.

The features claimed for this battery are the dispensing with the heavy leaden plates, bars grids, etc., and the employment of active material in the form of masses of dough or paste readily polarized by the passage of the current.

Proposed Electric Railway between Rochester, N. Y., and Lockport.

It is proposed to construct an electric railway between Rochester, N. Y. and Lockport. The original project of building a line between Rochester and Buffalo has been abandoned for the present at least. A branch road will extend from Lockport to Olcott. The total length of the road will be sixty miles, the longest line operated by electricity.

Consents have been obtained from property owners representing fully nine-tenths of the frontage on the proposed line. Little opposition to the scheme is anticipated. The projectors have decided to build the road in three sections. A company will be incorporated under the name of the Lockport & Olcott Beach Electric Railway company, to build the road between Lockport and Olcott.

The line between Rochester and Lockport will pass through many thriving villages, and one of the finest farming sections of the country. The entire distance is a natural grade, and the cost of construction will therefore be reduced to the minimum. The fruit growers along the surveyed route of the proposed road have signified their intention of using it extensively in marketing the products of their orchards. A committee of those interested in the new road has been appointed to confer with the Rochester railway company with a view to securing right of way over the latter company's tracks into the center of the city.

An overhead trolley system will be used. The road will cost at least $500,000, it is claimed.

Suit against Edison.

According to dispatches from Boston an action has been instituted against Edison by E. B. Welsh of Boston to recover $250,000 damages for an alleged half interest which the latter claims to have in all the inventions and improvements made by Edison in the transmission of messages by telegraphy. This suit was brought in 1884 in the United States Circuit Court, and the plaintiff claims that Edison made a contract in April, 1869, by which he agreed, in consideration of various sums of money which Welsh had loaned him, to experiment on the invention which he was at work upon for use in telegraphic transmission. At this time Mr. Edison was in the employment of the Western Union Telegraph company in Boston, and the plaintiff was in the employ of the Franklin Telegraph company. Last week, in the Circuit Court, before Judge Nelson, a motion was made by the defendant to have an auditor appointed; that the plaintiff be ordered to produce certain documents which defendant thinks are in his possession, and that the court order the plaintiff to answer certain interrogatories. The plaintiff makes objection to answering these interrogatories, and also objects to the other motions of the defendant. The defendant's answer in the case says that the plaintiff has no rights against him at law, and that the alleged agreement was of a limited time, and has been satisfied and terminated.

Frankfort Electrical Exhibition.

The Frankfort exhibition, says the London *Electrical Review*, comprises the following distinct departments, several of which are a considerable distance from the principal scene:

1. The exhibition grounds close to the Central railway station, with an area of 77,000 square meters, of which 21,200 square meters are covered with buildings. The most noteworthy of these buildings are the machinery hall, the boiler house, the hall for telegraphy and telephony, the hall for conducting and distributing cables and material, the hall for installations, the hall for railway material, the hall for medical and scientific instruments, the hall for electro-chemistry, the hall for parts of machinery (engineers' sundries), and the workshop buildings, containing all kinds of machines and tools operated by electric motors.

2. The maritime exhibition on the river Main, with a lighthouse and several electric boats, the largest of which is constructed to carry 100 passengers.

3. The captive balloon on the square in the Kaiser Strasse. Winding gear actuated by electric motor.

4. The installation in the Palm Gardens, which furnishes electric energy for the exhibition grounds.

FIG. 1. FRANKFORT EXHIBITION.

5. The electric tramway leading from the principal exhibition to the maritime exhibition. This line is worked with overhead and underground conductors.

6. The electric tramway running from the exhibition grounds to the Operplatz; this is worked with cars deriving their energy from overhead conductors as well as with accumulator cars.

7. The Frankfort Waldbahn, worked with storage battery cars which are charged in the exhibition.

8. The installation for electric transmission of power at Offenbach, 10 kilometers distant, which supplies energy to numerous motors in the principal exhibition.

9. The waterpower and electric installation at Lauffen, 175 kilometers distant, transmitting 300 horse power to the Frankfort exhibition.

10. The telephonic transmissions of music, viz.: from the pavilion of music in the exhibition to the car of the captive balloon; from the music room of the military band in the Frankfort infantry barracks; from the stage of the Opera house in Frankfort; from the stage of the Royal theater in Wiesbaden; from the stage of the Court theatre in Munich—from all of these the delightful sounds are transmitted to numerous isolated chambers in the telephonic hall of the exhibition.

Contrasted with the Paris electrical exhibition of 1881, one is struck with the fact that the Frankfort show does not bear the international character in anything like the same degree. England and America were represented at Paris. At Frankfort, however, there is a splendid demonstration of the vast strides made in the electrical industry by Germany and Switzerland. These countries have made an immense effort to prove their capacities to the world, and we have no doubt that the Frankfort exhibition will lend German and Swiss enterprise additional importance in the foreign markets. Out of ten English exhibitors, three are engine and boiler makers; one a glass cutter and spinner applying electric motors to his tools; one firm shows ventilators worked by electric power; one insulators; another incandescent lamps, made in Germany; one of our largest telegraph companies exhibits samples of its instruments, and finally one of our general electric supply firms, through its Hamburg agency, shows sundry fittings, bells and instruments.

None of England's largest manufacturing concerns have accepted the invitation of the Frankfort exhibition committee, and this leads to the conclusion that Englishmen have grown tired of international exhibitions—not in the capacity of visitors, for Paris in 1889 proves the contrary—but as participators in the race for fame and notoriety. France,

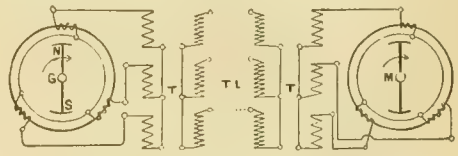


FIG. 2. FRANKFORT EXHIBITION.

as a matter of course, is not represented. Austria sends a fair number of exhibits, but we miss two of the most prominent firms. The United States of America was satisfied to be represented by four exhibitors. Altogether there are nearly 500 exhibitors mentioned in the catalogue, 100 of which have only sent drawings and designs of a technical character. With a few exceptions, Germany commands the field in a manner worthy of every praise.

Much attention is being directed to certain systems which the Germans designate "Drehstrom." This "Drehstrom System" is a multiphase transmission which will be adopted in the experiment between Lauffen and Frankfort, and which is carried out jointly by the Portland Cement Works at Lauffen, which puts its 300 horse power turbine at disposal, the Maschinenfabrik Oerlikon and the Allgemeine Elektricitaets Gesellschaft, which supply the dynamo, transformers and instruments at the generating station, motors and insulators, and lastly the government, which undertakes the erection of the conductors—three wires of 4 mm. diameter, each 175 kilometers in length. The intention is to work with a pressure of 25,000 volts. The German Emperor has granted 10,000

marks toward a portion of the cost of the leads. The two companies supplying the electrical plant have guaranteed under a penalty of 51,000 marks to have the installation in working order at or before the middle of August next. For this transmission 2,600 telegraph posts, 9,000 fluid insulators and about 60 tons of copper wire will be used. The details of the design are carried out by Mr. Brown of Oerlikon and Mr. Dobrowolsky of Berlin.

No practical data, giving one a clear idea of the working efficiency of this system, has as yet been made public. Dr. Epstein endeavored to explain away the false notion that we have here to deal with a new kind of electric current, and emphasized the fact that we have still only the continuous and the alternating current. But the multiphase generator gives a combination of alternating currents which cannot be produced in the simple alternator nor by a direct current dynamo. The arrangement is such that the alternating currents developed in distinct and separated coils on the armature are opposed in their phases, and are each separately led to the points of application; the electromotive force of each current starts from zero up to the positive maximum, again through zero to the negative maximum, not for all the currents simultaneously, but at intervals which bear a certain relation to one revolution of the machine; the successive currents change their role in cyclic order, and the sum of the electromotive forces of the system is a constant quantity. Comparing the three-wire continuous current system with the three-phase or "Drehstrom" system, we have in both cases three wires; but in the former case the potential difference between two neighboring wires is only half that between the outer leads, whereas the mean potential between any two wires of the three-phase system is the same. In the multiphase circuit we have, as in the case of a continuous current circuit, a steady flow of energy which is assumed to be constant. The individual currents, however, which produce the sum of effects, are distinct alternating currents capable of being converted through a stationary transformer.

The particular advantage of this system must be found in the fact that all the circuits have the same value; *i. e.*, a group of incandescent lamps may be joined to any one pair of leads. Moreover, electric motors, constructed on this principle, are exceedingly simple, start from any position, and do not come to a standstill in the case of temporary overloading for short periods of time because it can never occur that all the leads are without current. Referring to the history of this system, the original idea emanates from Professor Ferraris, of Turin. Mr Tesla made some practical use of it in the year 1888; he demonstrated the branching off of separate alternating currents of different phase from a single armature. In the following years, and almost simultaneously, Bradley of New York, Haselwander of Offenburg, Dobrowolsky of Berlin and Wenstrom of Stockholm made further improvements which permit of the number of leads being equal to the number of currents. The word "Drehstrom," although misleading, has its origin with Mr. Dobrowolsky, and he justifies the expression (rotary current, literally translated) by the following phenomena: Taken a compass needle surrounded by a coil; a continuous current sent through this coil gives the needle a definite deflection; the alternating current causes the needle to vibrate in the north-south position; the "Drehstrom," however, gives the needle a rotary motion. But it is also possible to give the needle a rotary motion with the current of an ordinary alternator.

The following description is due to F. Haselwander, one of the earliest workers in this field, and who has applied for patents and showed the system in operation in the month of June, 1888.

Fig. 1 shows diagrammatically the arrangement of generator, motor and leads. Both machines have a stationary armature and rotating fields. For the sake of simplicity, only three bobbins and two poles are indicated.

Fig. 2 represents the same machines with transformers interposed between the three transmission leads. Instead of the three phases, two or more can be arranged; the interlinked three phase current is simply the solution of the problem to obtain with a minimum of transmission leads the largest number of currents of different phases. Any continuous current machine can, after removing the commutator and substituting in lieu of its segments half the number of transmission leads, be converted into a multiple-phase machine. It is immaterial whether we rotate the field or the armature. The first machine of this kind was tried in October, 1887. This had a fixed armature made in the form of a ring out of iron wire; this ring was 400 millimeters in diameter, 180 mm. broad and 30 mm. thick. It was wound with 12 bobbins, each bobbin of 52 turns; the copper wire being 1.5 mm. thick. The ends of the bobbins were led to terminals fixed round a wooden disk. These terminals could be joined in a variety of ways, so that the machine was capable of giving 50 volts with 48 amperes; 100 volts with 24 amperes, or 200 volts with 12 amperes, with 960 revolutions per minute. Within this armature was a four pole magnet keyed to the rotating shaft; the cores were 80 mm. in diameter and 80 mm. long, including pole pieces. The winding of these magnets consisted of 672 turns of copper wire 1 mm in diameter on each of the four cores. The armature and bearings were supported by a strong cast iron frame. The total weight of the machine was 303 kilogrammes. Each kilogramme of copper wire gave an output of 160 watts. For the purpose of self-exciting there was a commutator, which was sparkless with a constant load.

According to the *Review* the multiphase motor is an exceedingly simple apparatus, easy to construct, and equally easy to manage. Efficiency tests have been made, says our contemporary, with a motor of normally 2 horse power running at 70 volts, at periods of 35 per second. The weight of this machine was 165 kilogrammes, and it was found that it did not get unduly warm when running for long periods at 2 horse power. For a short time it could be loaded to 4 horse power on the shaft, without very serious reduction in efficiency. The variation of speed between running empty and with a load of 2 horse power was only 6 per cent., and by overloading the motor 100 per cent, the speed was still appreciably high, showing its superiority over alternating current motors, which stop altogether when overloaded. When running empty, the motor consumed 205 watts, and the mechanical work when applied, increased almost in exact proportion with the electrical energy used, until it reached 3 horse power, when it fell somewhat. A series of tests demonstrated that the efficiency of this motor at half a load, or 1 horse power, was 75 per cent.; at its normal load, 2 horse power, 80 per cent., and it reached the maximum, when giving 2 3 horse power, when it was 81.4 per cent. The speeds, unfortunately, are not given.

Another important fact may be noted, and that is that a multiphase motor starts from any position, and exerts a very considerable initial torque. At the moment of starting a resistance is inserted, and this resistance can also be used for varying the speed where it is desirable. Even when overloaded the starting does not occupy more than two or three seconds, and the rotation of the motor can be reversed in about four seconds.

Lahmeyer & Co. exhibit several of these machines, of more modern construction. The transmission of power between Offenbach and Frankfort (10 kilometers) is carried out with this system.

Electrical Department, World's Fair.

Chief Barrett of the Department of Electricity was out of town all last week and consequently but little was done in his department. It is expected that the appointment of an electrical engineer for this department will shortly be announced, but of course this depends upon the return of Prof. Barrett.

The annoucement in the WESTERN ELECTRICIAN last week that the contracts for the construction of the electrical building had been awarded, and that the original plans regarding space allotted this building had not been changed, was received with marked disapproval by the entire electrical fraternity. Expressions of regret were heard on all sides. Commenting on this action *Electrical Industries* says editorially: "As we go to press it is announced that the contract for the electrical building of the World's Columbian Exposition has been let, and that construction will presently be commenced. This, of course, precludes any change of plans, and renders further efforts to secure a united exhibit useless. While it is to be regretted that the electrical interests have failed to secure what seemed essential to the greatest success of the electrical department, it is gratifying to know that some of the results, at least, which it was thought would be best obtained by a united exhibit, will still be secured." Despite the disappointment of the electrical people they will endeavor to make a great display and contribute as far as possible to the success of the exposition.

Applications for space in the electrical building are constantly coming in. Among the latest requests of this character are those of J. Lang & Co., Chicago, switches and other appliances, 80 square feet; H. S. Paiste, Philadelphia, switches, sockets, etc., 200 square feet; Commercial Cable company, specimens of submarine cables, instruments, etc., 150 square feet. The last named company will also show a model of a cable repairing steamer, which will be an object of much interest to the general public.

J. C. Koch of Hohenlimburg, Germany, has written a letter addressed to the Chicago Exposition, inclosing a sample of his woven wire commutator brush, which he evidently desires to have used on the generators at the big power station. He claims many advantages for his wire brush and asserts that "all other brushes known up to the present time are, in comparison to my brushes, mere instruments of destruction to the commutator."

A letter has been received from Paris asking for Prof. Barrett's portrait to adorn the "Bulletin of the Chicago Exposition for the European Nations."

In pursuance of the subway scheme for electrical conductors outlined in the WESTERN ELECTRICIAN of last week, Chief Burnham has, on the recommendation of Engineer Sargent and with the consent of Chief Barrett, appointed Messrs. Speltzer and Bradley as draughtsmen to assist Mr. Sargent in preparing the subway plans. These gentlemen entered upon their new duties last Monday.

Two papers were read before the Franklin Experimental club at Newark, N. J., June 2d. W. J. Hammer discussed "Facts and Phenomena about Incandescent Lamps," and Earl Atkinson presented a paper on "Electric Motors."

Present Theories Concerning the Nature of Electricity.

Following Prof. C. S. Cook's paper before the Chicago Electric club on "Present Theories Concerning the Nature of Electricity," presented in the last issue of the WESTERN ELECTRICIAN, this discussion took place:

THE CHAIRMAN: I think the paper that we have heard this evening, and a very able paper it is, will be of great benefit to the society inasmuch as it will tend to make our members consider some things which we ought to think about occasionally. Instead of devoting our whole attention to the question how to make a little more money out of electricity it will tend to make us examine more into the origin and causes of these things.

E. A. SPERRY: Thos. D. Lockwood, who is present this evening, has been permitted to see some experiments which I think are generally credited with having a very direct bearing upon the relations of light, and ether and electricity—those of Tesla—and I for one would be very much gratified if he would tell us something of them.

THOS. D. LOCKWOOD: I came here this evening, after reading for a number of years the accounts of your meetings, which I found in the pages of the WESTERN ELECTRICIAN and which were of very great interest to me, and was specially interested in the very able discussions which were there recorded. I have not been disappointed in the paper this evening. I think that certainly is as interesting, as able and as thorough as any of the papers which I have seen recounted there. I think we are all of us greatly indebted to Professor Cook for the able and painstaking way in which he has laid these matters before us to-night, keeping before our minds all the time, for our guidance that the theories which he has laid down are theories.

For my part I will admit that electricity has seemed to me to be particularly a science of experiment. I have, perhaps, as much as most men, become acquainted with the history of electrical science; I am not one of the experimenters, and therefore, have no hesitation in saying that it seems to me, wherever theory has been successful in electricity, it has been just a little way behind experiment, and never in advance of it.

I believe that the double fluid theory was as useful in its day as any of the theories, which we have just heard have recently expired. I believe that the theory of the single fluid, or positive and negative electricity, was as useful as the double fluid theory. I am not, however, prepared to quietly acquiesce in the statement that the theory of molecular propagation so ably expounded by Faraday, has altogether passed away. It seems to me that we are too ready to lend a listening ear and an acquiescing mind to every new theory as it comes along. I am not at all sure that the experimentalists and the students of 100 years from now will not be equally ready to discard any theories we may now advance as being absurd and effete, something that did well enough for the ancients, but quite unfitted for 1991.

I hope that this science which we all practice more or less imperfectly will still continue to bear the name electricity. It was given that name by one who may properly be called the father of electricity, William Gilbert. Gilbert showed four things, some of which we still hold. He showed us that the earth itself was a great magnet. I believe the world of science holds that view in spite of all the changes in modern theories. He gave us the name electricity. He first distinguished between electrical and magnetic phenomena, and he showed us that many things besides amber were susceptible of electrical attraction. When I think of the great number of hypotheses—I think many of them are more worthy of that name than of being called theories—that have been successively raised and exploded, I feel like giving great honor to Gilbert, of whom Lord Bacon speaks when he says, "Electricity concerning which Gilbert has told us so many fables," for at that time it was not easy to believe even practical truths when told by practical men in a practical way.

In regard to the experiments of Mr. Tesla, to which Mr. Sperry has referred, it was indeed my privilege to be present at a lecture which Mr. Tesla gave in the hall of Columbia College, New York, some two weeks ago. Mr. Tesla performed some exceedingly beautiful and interesting experiments, and gave a remarkably instructive lecture; the interest, however, being somewhat modified by the fact that Mr. Tesla devoted the first hour of his lecture to the inquiry what electricity is. Now it is, no doubt, highly important that we should some day know or that our successors should some day know, what electricity is, as well as what ether and magnetism are. But to me it seems far more important to learn what magnetic or electrical energy can do. We must not forget however, that there is one grand reason for keeping up this research for the purpose of finding out what electricity is, and that is that when we do find what it is we shall have a better conception of what it can do than we can ever obtain, only knowing as we now do what it is not.

I remember one experiment by Mr. Tesla which made a very marked impression on my mind. The lecture was devoted to the consideration of the phenomena produced by alternate currents at high frequencies. He had a complete arch of brass, and he had an incandescent lamp which was connected with some wires. The lecturer sent alternate currents at a most wonderful rate of frequency through this arch which might be supposed to short circuit them completely, and this incandescent lamp he would place at different points until he had got within four inches of the brass rod, and yet the lamp was made incandescent by alternate currents passing through the arch. He argued that that showed the wonderful possibilities in what might hereafter be done in the study of alternating currents.

The speaker of this evening mentioned one fact which should be of interest to practical men, and that was that when alternating currents were sent through a wire at high frequencies, they seemed to traverse that wire only skin deep.

I do not know what the practical lessons are that we shall ultimately derive from this knowledge; but it may be

that we shall discover some way of making the wires hollow, and if we can do that we shall accomplish a great economy. If we have a thick wire and find that we can send the current along the outside of it—it must be alternating currents to do this—we can take the copper wire and hollow that out making another wire, and then hollow that out and so on, and we shall have made a very great advance in electrical science!

In that connection I may mention another of the theories of Professor Lodge. He proposes to regard wires as being simply holes through an insulator from one end of the wire to the other, and the electricity or electrical energy is supposed to travel through those holes and the dielectric or surrounding insulator is supposed to have the effect of carrying or supporting the electrical energy. This reminds me of something that was told me yesterday by Frank G Beach of a very singular phenomenon which was witnessed at one of his western telephone stations last week, where there was a lightning storm. The lightning entered the house of a subscriber, broke away the plaster where the wire came through, and passed through a great many feet of cotton covered wire. It melted and dissipated the copper wire completely, but the telephone apparatus escaped damage, about three inches of wire attached to each binding screw being left. The singular part however, was the fact that it did not burn the cotton covering at all, but simply left it in the same shape as Professor Lodge's holes through the dielectric. (Mr. Lockwood here exhibited the unharmed cotton covering of the wire to which he had just referred. The cut is a reproduction of a photograph of the cotton cover) I doubt, however, whether the electrical energy would travel through that kind of perforation of the dielectric as well as through one made by wire. I do not undertake to explain that singular phenomenon at all. I have no doubt that this and other remarkable phenomena could be easily explained by some of the various theories we have. It would seem that the copper must have been completely fused and reduced to powder before any action took place in the cotton.

MR. SPERRY: I wish to call the attention of those who may examine this cotton that the color is still there. Just think of that for one moment—a number 18 wire removed absolutely without even affecting the color of the cotton! That is to me startling as well as wonderful.

I had hoped that Mr. Lockwood would recall the experiment in which Tesla was enabled to produce light seemingly without heat or any of the other manifestations of other energies that we always associate in our minds with heat. I understood that Tesla had a large sheet of zinc placed at each end of the platform and by means of two tubes which he held in his hand he was enabled to illuminate the whole room by simply approaching the tubes to the two sheets of zinc, employing rapidly alternating currents.

MR. LOCKWOOD: That is the one that would not work.

MR. SPERRY: From the account I heard there were manifestations that showed the principle still remained. The explanation of these phenomena, had the experiment been successful, might be traced in some remarks made by Professor Hertz during the last six months. He looks upon the phenomena of ight as so closely related with those of electricity that by simply reducing the wave length and the atomic vibration light may be produced without heat, and in that way illumination secured with the least possible expenditure of energy or mechanical force. It would seem from some of the experiments performed by Tesla in New York a couple of weeks ago that while he was unable to give any rational explanation of these phenomena, he had been able to approach more nearly the ideal conclusions of theorists than has been done heretofore.

I remember recently having read that Newton, the discoverer of the laws of mathematics and gravitation, was himself convinced that this ether existed, and so thoroughly did he believe it that he was led to cast a slur upon those who thought that this, to him, all pervading fluid did not exist. He based his mathematical considerations on the fact that this ether did exist; so there is nothing startlingly new in the assertion of this all permeating ether.

Henry discovered the effects of the rapid alternation of a Leyden jar, upon which Hertz has built those wonderful demonstrations of Maxwell's laws. We find in the writings of Henry that he had a very complete conception of the existence and workings of this ether. He followed in the footsteps of Franklin, as I understand it, and explained the phenomena of the excitation of electricity upon a body by saying that electricity was one fluid, and that upon one pole of the body this fluid was condensed, and upon the other it was correspondingly rarefied. One of the experiments confirmatory of the theory was that in which two glass rods, a pith ball and a ball of woolen yarn are employed That was one of the experiments upon which Henry depended for the substantiation of that particular theory, which was shared by a great many other scientific people about 1830, when Henry wrote on these subjects. I think too much honor cannot be paid Henry for his very acute observations with reference to the alternations of the discharge of a Leyden jar, especially as Professor Hertz has lately been enabled to evolve so much of the truth that places current theories on a right basis.

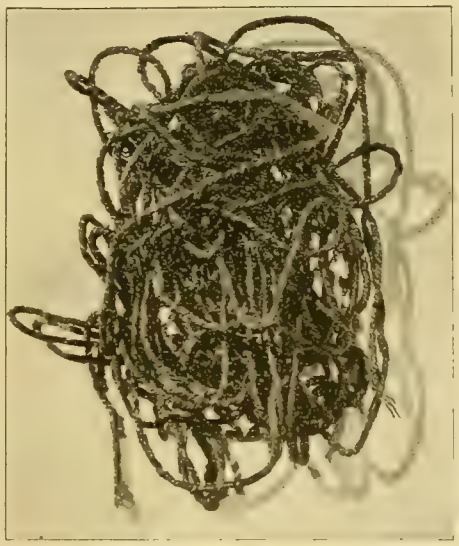
MR. GRIER: It has been my province to apply the known action of this unknown something. The question is, What is electricity? What is gravitation; what is matter; when was the beginning? We discovered matter, I suppose, as soon as we were; gravitation was also discovered in a like manner; developments later on gave us the science of chemistry, which is the science of matter to a certain extent. We have now the laws of gravitation; we have the laws of electricity; we can apply these laws in a practical way but as we do not know where the beginning was, so we do not know where the end will be. I have not the slightest doubt that when we discover what electricity is we shall discover what all the others are.

MR. DOW: I have to disclaim, with Mr. Grier, as a practical man any exploration of those fields that have been opened to us by the paper of this evening, and I would say for him and for myself that we accept the working theories that are handed down to us just as the sailor accepts the nautical almanac, as being good until a new one displaces it; or as we accept the working drawings that come with the machinery, as being good until experience proves they are not. The days of the practical electrical engineer are spent in fighting misplaced matter and mis-directed energies, and he may amuse himself and exercise his mind nights and Sundays, provided he does not work Sundays, by studying the abstract theories of electricity and of ether, but I am afraid, to judge from my own experience that his thoughts on such occasions will naturally and irresistibly turn into channels connected with his daily work in the hope that possibly he may find an easier track than the one in which he has been plodding the preceding week.

MR. KELLY: It impressed me that there must be something wrong about the idea of rapidly alternating currents not entering the wire very deeply, or the part of the current entering the wire being lost as heat. It seems to me that theory must be wrong for if that be true all that would be required to transmit electrical energy would be to furnish a continuous dielectric with a hole through it. If there were no copper wire to take up the energy there would be no loss in heat.

THE CHAIRMAN: The matter of that copper disappearing is not so wonderful; I have had gold disappear from pockets and leave nothing but the cotton surrounding it.

F. L. PERRY: In regard to the disappearance of the copper in the case of the telephone wire, referred to by Mr. Lockwood. I think the phenomenon may be explained in the same way as you explain the disappearance of a bullet from a tissue paper wrapping when you put a pin hole in the bottom and hang it over a gas jet. I have hung a bullet, wrapped in several layers of tissue paper, over a lamp and melted the bullet leaving the paper virtually unharmed. If I could get heat enough to melt



PRESENT THEORIES CONCERNING THE NATURE OF ELECTRICITY.

that bullet, it seems to me that by suddenly heating the wire by electricity to a point beyond incandescence the copper might be melted in a similar way.

MR. LOCKWOOD: I have no doubt that is the true explanation. When Mr. Beach told me of this yesterday, I was reminded of some experiments of my boyhood, when I used to make a mixture of saltpeter, sulphur and charcoal, and I used to place this mixture in a walnut shell and when the explosion would take place the shell would be left, and the cover would be burned. The only thing to think of in this case is that the electrical energy worked so swiftly that it didn't have time to touch the cotton covering

MR. SPERRY: As Mr. Lockwood says, if there is any one part of that paper which is absolutely certain, it is that with reference to the skin deep action of alternating currents in the wire. That has certainly been proven beyond cavil to be a fact, and it is assumed as one of the great foundation stones of this theory. There is no doubt whatever about the certainty of that action. It seems to lead one to think that Professor Lodge's explanation, which has been talked of freely for the past year, was that a wire was merely a hole through a vast ocean of ether, and that it was really in the ether that the energy was transferred, while it was in the hole that the fluid was squeezed out. The mathematical deductions of Sir William Thomson recently, in reference to the practical application of high alternating currents, has removed that part of the matter out of the realm of theory entirely, and made it a matter of fact in common practice.

Van Nort Bros. of St. Louis have just placed 50 incandescent lights, together with arc head light and boom light, on the steamer Lily. They are now lighting the "City of Paducah," a new boat just being finished for the Tennessee River Packing company with an arc light outfit

According to the law recently enacted to regulate electric lighting in Iowa, no gas works or electric light plants shall be established by any city or town until a majority of the legal voters thereof, at a general or special election, decide in favor of the improvement. The council may order the question whether such gas works or electric light plant shall be established by the city or town submitted to a vote at any general election, or at any election especially called for that purpose.

A Thermo-Electric Method of Studying Cylinder Condensation in Steam Engines.[1]

BY PROF. EDWIN H. HALL.

The subject of cylinder condensation is one that possibly would come more aptly before the mechanical engineers than before the electrical engineers, and yet most electrical engineers are to a greater or less extent mechanical engineers, and the time when we can dispense with the steam engine in the practical applications of electricity seems not yet to be near. The methods for turning the energy of coal directly into electric currents, I believe have not yet been put into application.

The subject of cylinder condensation is one that has always been prominent in the study of the steam engine. Before the time of James Watt at every stroke the cylinder was filled with steam and then it was cooled down by pouring water on the outside, or by admitting water into the inside, so that whenever the steam was admitted it found the cylinder cool. A large part of the steam admitted at every stroke was turned into water at once on admission, and some of it was doubtless turned back into steam during the stroke, but much of it went out as water in the end. Watt introduced the independent condenser by means of which the steam is removed from the cylinder without cooling the latter down, as it was cooled before; and yet, it is still believed that a very considerable part of all the steam that enters the cylinder is condensed upon the inner surface of the cylinder; that some of this is re-evaporated during the stroke, but that a very considerable part remains as liquid at the end of the forward stroke, and is only turned back into steam during the back stroke, when it is a disadvantage rather than an advantage, for it has to be expelled by the returning piston It is considered that in some engines as much as 25 per cent. of all the steam that enters the cylinder goes through the cylinder as water—that is, during the forward part of the stroke.

The cause of cylinder condensation is that when the cylinder is thrown into communication with the condenser, rapid evaporation takes the place of the water remaining on the wall, and that rapid evaporation under the diminished pressure cools greatly the cylinder wall. A little more than two years ago, Jan. 17, 1889, Mr. Dickerson of New York gave an address before the Electric club of that city, in which he advanced the proposition that the peculiar character of the indicator card of a steam engine which was supposed to show cylinder condensation and re-evaporation was due to leakage by the valves—leakage in by the valves at one part of the stroke, leakage out by the valves at another part of the stroke. He made the statement that the steamers in the waters about New York city would travel four or five miles an hour with the valve between the boiler and the cylinder closed. Mr. Dickerson's paper excited my interest—perhaps more than it would had I been trained a steam engineer. I knew that this was a matter in controversy between steam engineers—that they were by no means decided as to the amount of cylinder condensation, nor as to what caused the cylinder condensation, some believing that the steam entering at *a*, Fig. 1, was cooled by contact with a layer of water remaining over from the previous stroke—the layer of water upon the inside of the cylinder. They thought that you could hardly account by the action of the iron alone for the very sudden condensation of such a large amount of steam. Mr. Dickerson's paper, then, stimulated me to undertake an investigation of this matter in a direction in which it had not been approached before, so far as I know. Steam engineers have invariably, so far as I know, examined this question by study of the indicator card, examining the pressure at different parts of the stroke—the pressure and volume, and finding out how much steam they indicate. Knowing the pressure at this part of the stroke, *C* Fig. 2, and the volume occupied by the steam we can tell what weight of steam there is in the cylinder as steam. It is found frequently that there is more steam in the cylinder at the end of the stroke than at the beginning of the expansion. According to Mr. Dickerson that was due to the leakage by the valves by which steam was admitted, when the pressure in the cylinder fell low. It seemed to me that we might test the question how much heat enters the cylinder wall by a thermo-electric method. Let Fig 1 represent the thickness of the cylinder wall. *O* is a hole which in the engine referred to is bored for attaching the indicator. It is about ⅜ of an inch in diameter. The thickness of the wall is about ½ of an inch—a little more than that. I screwed into that hole a plug, Fig. 3, having at this end, *i*, a slice of iron—I had steel at first—of known thickness. Into one hole I put a bar of antimony *A*; into the other a bar of bismuth, *B* The two were insulated from the plug. It is known to all of you that bismuth and antimony make an excellent thermo electric pair—the best that is in practical use. If I connect the antimony with the copper wire, *g*; the bismuth with the copper wire, *c*, and lead those wires to a galvanometer, I shall get a current through that galvanometer whenever the two junctions here, *a* and *b*, are at a different temperature from the section where the antimony and the bismuth strike this slice of iron. If I put the ends of these rods of bismuth and antimony into a pot of paraffine and heat the paraffine when I get the temperature of these two junctions *a* and *b* where the copper joins the bismuth and antimony, the same as the temperature where the antimony and bismuth strike the iron the current will cease. If the temperature here is below the temperature there, I get the current in one direction. If the temperature here is higher than the temperature there, I get a current in the opposite direction. That was the beginning of the method. But it presently occurred to me that it would not do to use bismuth and antimony, for the reason that the heat conductivity of those substances was so different from that of iron. My purpose was to find what the temperature was at a certain thickness in the cylinder wall at a certain part of the stroke. I close this circuit at *g c*, at a

[1] Abstract of a paper read before the American Institute of Electrical Engineers, May 20, 1891

particular part of the stroke by means of a cam upon the crank. I can close the circuit at any part of the stroke for a short time)[1].

It being my purpose, I say, to find what the temperature is at a particular depth in the iron, I wished to have that temperature as exactly as possible what it would be if this iron were in a normal condition, that is, if this were in a solid cylinder instead of being in a prepared plug. To get that I found it necessary to have for these bars, *A* and *B*, Fig. 3, a heat conductivity which was more nearly like that of iron than the heat conductivity of antimony and bismuth is. So I cast about for some metal which would with iron itself make a good thermo-electric couple, and of which the heat conductivity would be very like that of iron. Nickel, suggested itself. Nickel and iron make a very good thermo-electric pair. I determined to make my plug in this way. Fig. 4 shows a plug with a hole bored completely through it. A slice of cast iron represented by *S* is ground to a particular thickness, and is screwed on at the end of the plug, making a steam-tight joint—at least I meant it to be steam-tight.[2] Into this hole I put a core of nickel insulated from the iron except where it strikes the slice. The nickel is soldered to the iron in this way. The slice is tinned very thinly, the end of the nickel core is also tinned. The two are heated and then in a vise they are held together until they are cooled, so that the thickness of the solder is not more than a thousandth of an inch. The

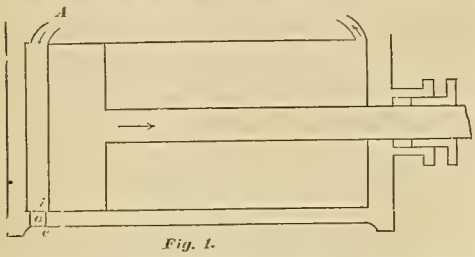


Fig. 1.

soldering was done with the slice and a nickel core in place, the slice being screwed to the plug, and the core being surrounded with a single layer of paper to keep it free from the iron except at the bott m of the hole. Slice and core were removed from the plug after soldering, and the solder which had been squeezed out from the joint by the action of the vise was carefully turned off in a lathe. The distance from the outer end of the core to the farther surface of the slice was measured carefully before soldering and after soldering. In no case did these measurements show the thickness of the solder to be as much as .02 mm

I know very definitely, then, the depth at which the contact takes place. Now as to the heat c nductivity of nickel, I can find no data in the books. I believe no information in regard to it turned up in my studies. But I knew from the relation of its electric conductivity to that of iron, that the best conductivity ought to be nearly like that of iron, for usually heat conductivity and electric conductivity go hand in hand. I had to have a bar of nickel make for the experiments. It was a yard long and about one square inch in cross section. I determined the heat conductivity of that by comparison with a simular bar of cast iron. I found that the heat conductivity of nickel is rather less than that of cast iron, perhaps 15 or 20 per cent. less[3] but still, nearer the heat conductivity of cast iron than any other metal that I could get that would make with iron a good thermo-electric junction. The specific heat of nickel is near that of iron, which again is as important, perhaps, as the matter of thermal conductivity. Now from the nickel core I lead a nickel wire, both being made from the same bar of which I had determined the conductivity from the iron an iron wire. This and the one of nickel were slender bars about 15 cm long rather than wires proper. The junctions *i* and *n*, Fig. 4, are put in a pot of paraffine and go through the processes which I have indicated already.

I had three plugs made. With one the slice of iron was half a millimeter thick (.051 cm.), with the other a millimeter thick (0 101 cm.), with the other two millimeters thick (0.203 cm) Let Fig. 2 be the indicator card from the engine with which we are making this test. I used first the plug w th the thinnest slice, and I f und the tempera ture at this depth of iron half a millimeter at that part of the stroke, *k*, Fig. 2, just before steam is admitted. I did the same with the millimeter slice and with the two milli meter slice. Let *D*, Fig. 5 represent 4 mm. of the thickness of the cylinder-wall, points at depths of ½ mm., 1 mm.

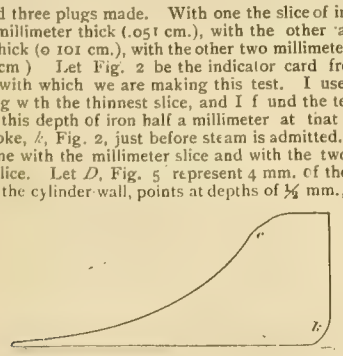


Fig. 2.

and 2 mm. being marked upon it. The curves presented are not perfect. Suppose that distances out here to the left from the line *D* represent excesses above 109 degrees — 109 degrees centigrade being the temperature of the outer surface of the cylinder wall. With the half millimeter slice at this part of the stroke, *k*, Fig. 2, I find an excess above 109 degrees of 8 or 9 which I will represent by the distance *a*. With the millimeter slice I find the temperature to be greater at this part of the stroke, and will represent the excess above 109 degrees by the distance *b*. With the two millimeter slice the temperature was not very different from what it was with the one millimeter. Through the tops of the lines, *a b* and *c* I draw a curve. (What I wish to do sometime is to be able to plot a curve-like that giving the temperature all the way down here inside the wall of the cylinder at this particular part of the stroke.)

I make similar determinations for that part of the stroke, *c*, Fig 2. I find the temperature at half a millimeter depth has risen to 131 degrees more or less. The temperature at a depth of a millimeter is a little higher. This point half a mm. deep, has already begun to cool. The fact is that in my engine the cut-off is like that (Fig. 2)—pretty gradual, so that re evaporation very likely begins before the cut-off is complete. I suspect, however, that 131 degrees is too low for the temperature at a depth of half a mm. At the depth of two millimeters the temperature is not as high as it is at a depth of one mm. At the depth of two millimeters in the iron there is, however, a jump of some four or five degrees centigrade.

One of these curves, Fig. 5, represents the condition of things at this part of the stroke, *k*. The other curve represents the condition of things at that part of the stroke, *c*. The curves are by no means accurate and they are very incomplete, but supposing them made perfect, I have merely to put on here a planimeter to measure the area between those two curves, and it is then easy to determine how much the heat in the cylinder at this part, *c*, of the stroke exceeds the heat in the cylinder at that part, *k*, of the stroke, and this excess of heat is the heat which has been given up by steam to the cylinder-wall, which has been done during the admission. Allowance should be made, of course, for the loss through the wall meanwhile. Then I compare that with the indicator card, and see whether the two are in agreement.

I have made some tests for points at other parts of the stroke. I found, as I have already stated, that at a half

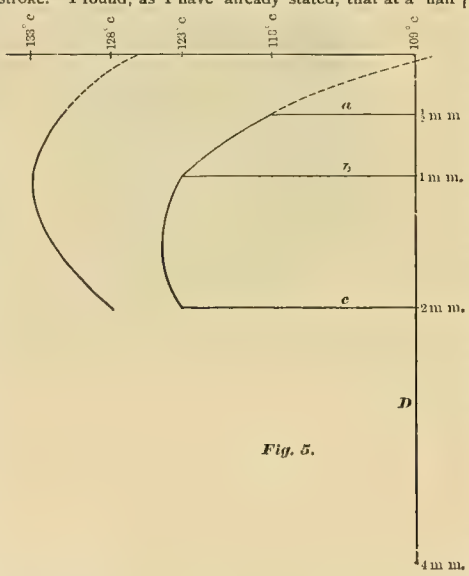


Fig. 5.

millimeter depth the temperature at cut-off has already passed the maximum, that it falls rapidly down here during expansion, and at this part of the stroke near release it is only a few degrees higher than at the end of the exhaust. But the parts deeper in the cylinder are of course slower to cool. In fact, the heat rushes into the wall here during admission; then as soon as the pressure is relieved, the water begins to evaporate from the inner wall here and the heat ebbs back, and is spent, some part of it, in forming steam during the expansion, but not all of it; a considerable part remains at the end of the stroke, to be spent in evaporating water which is still clinging to the wall of the cylinder. As I have said, this research is by no means complete, but it has gone far enough to indicate that a very large quantity of heat goes into the cylinder wall. A very rough calculation from my experiments indicates that in the engine I am using, Kendall & Roberts' 10 inch cylinder with 15 inch stroke, this maximum pressure I get here, Fig. 2, is about 33 pounds above atmospheric. I use an expansion of about 4 and about 60 strokes to the minute. According to the best estimate I can make, probably two-thirds as much steam is condensed upon the cylinder wall as remains active at the beginning of expansion. I should say that two-fifths, this is very likely an over-estimate, perhaps 1-3 would be safer, probably, of all the steam that enters that cylinder is condensed upon the cylinder wall upon the first quarter of the stroke. How much of that is re-evaporated during the stroke and so helps more or less, I do not yet know. According to the indicator cards taken during the experiments with the plugs the weight of steam in the cylinder at the end of expansion is about 1.25 times as great as just after cut-off. How much heat is absorbed by the layer of water which remains over from the previous stroke I cannot tell. I think there is some evidence that a layer of water does remain over from the previous stroke. This examination shows, however, that the iron is exceedingly effective in cylinder condensation, and it suggests the question whether it is not possible to coat the inner wall of the engine with something which would prevent, to a considerable extent, this condensation. It is not easy to find something with which one can coat the rubbing surface of the cylinder, I suppose, but there is the end of the cylinder and there is the face of the piston, and those two surfaces make, in the case of a short cut-off, perhaps more than half the area which is effective in this cylinder condensation It doesn't seem to me at all impossible that some comparatively non-conducting material can be found with which those surfaces can be coated so as very materially to decrease the cylinder condensation. Experiments for that purpose could easily be made with plugs of this kind. Instead of having to coat the whole cylinder one might lay on this plug some non-conducting material and see how much difference that would make in the amount of heat absorbed. I haven't attempted anything of the kind, but it doesn't seem fanciful to imagine that something valuable might come out of it, and a very large saving in the steam used in steam engines might perhaps be made in this way.

The research of which I have here given an account has been carried on with money from the Rumford Fund of the American Academy of Arts and Sciences.

For indispensable assistance in the investigation I am indebted to Messrs. Barron, Curtis, Hale, Kendrick and Sage, members of a class at Harvard College engaged in a study of the steam-engine.

DISCUSSION.

DR. W. E GEYER: I know of some experiments where an attempt was made to effect that saving of which Prof. Hall speaks, by using bismuth in parts of the cylinder.

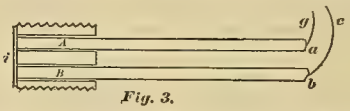


Fig. 3.

Bismuth is a metal having an extremely low conductivity of heat. Under the circumstances bismuth would not stand; it would gradually grind away, or be torn to pieces and would clog all the apparatus.

PROF. NICHOLS: I am not capable of discussing this paper from the standpoint of the steam engineer, but from the point of view of applied physics it is an exceedingly interesting paper, both on account of the line of work and the method employed and on account of the light which this method seems to throw upon the problem of heat in metallic walls. I would like to ask Professor Hall whether in his opinion something like lag is to be looked for in the performance of a thermopile on this method. Of course this thermopile is subjected to rather rapid changes of temperature at its junction. To what extent must its sluggishness be taken into account in interpreting the indications of the galvanometer, or does not that enter at all? I have often thought that this must be a factor which we should take into account in attempting to measure fleeting heat values at the junction of any thermopile. I have never looked into it in detail.

PROF. HALL: As the thermopile is ordinarily constructed there would be decidedly a lag. A thermopile is ordinarily constructed in this way: There is one bar, of antimony; here is the bismuth; and the two are soldered together for an indefinite distance. If you apply heat to the ends you do not know what you get; that is, if it is a fleeting thing, as you say. But you see what I have. I know what my junction is. There is a definite surface of contact; save for the very thin layer of solder already mentioned. When the heat strikes that I do not see how there can be any lag.

W. J. HAMMER: Would any advantage come from the electrical welding of the contacts there?

PROF. HALL: No; I do not think there would. I think electrical welding would make the thickness of the iron uncertain somewhat; I suppose the pressure you would have to apply might change it somewhat. I have a plug which I propose to try which shall not be soldered—the nickel core being simply held by pressure against the iron slice—to see what difference I shall get between this plug and the others.

GEO. G. GROWER: I would like to ask if it would not take an appreciable time for the heat to penetra e a depth of metal of half a millimeter, a millimeter, or two millimeters. I should think there would be an appreciable interval of time of penetrating that depth of metal, so that instead of getting the temperature at the portion of the stroke expected it might be at an advanced portion of it.

PROF. HALL: What I want to know is not the temperature at the inner surface, but the temperature at my junction. The lag (in one sense) is the very thing I am investigating. I test that for different depths. If I know what the temperature is at a certain depth at one part of the stroke and what the temperature is at the same depth at

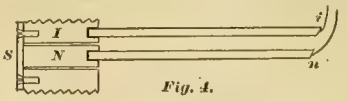


Fig. 4.

another part of the stroke—if I can tell how much heat has gone into the iron between one part of the stroke and another part of the stroke—that is all I want.

The Franklin, Ind., Water, Light and Power company writes that it has secured the electric light franchise in Franklin for eight years. It will install a 70 light arc plant complete, including engines, boilers and poles.

An electric light and water company has been organized at Gallup, N. M. The object of the company is to furnish electric lights and water for the town of Gallup, which is a large coal mining camp, with at least 2,000 people. Articles of incorporation have been drawn up, and will be sent to the territorial secretary.

[1] In my latest experiments the fly wheel has made about 60 revolutions per minute, and contact has lasted about 1-60 part of a revolution The cam pushes two pieces of brass together without touching either of them directly Springs hold the two slips of brass apart when the cam is not acting.

[2] In some of the experiments this joint was not perfectly tight, for water was sometimes seen to come out by the core N before the plug became hot. Generally on such occasions the leaking appeared to cease when the plug became hot The fact probably is that the joint continued to leak slightly, but leaked dry steam, the temperature at the outer end of the plug being about 100° C and at the inner end considerably higher. Both experiment and reason indicate that the effect of such leakage upon the temperature found was slight.

[3] The nickel used was of fair commercial quality. I am not yet prepared to publish details of the measurement of its conductivity.

CORRESPONDENCE.

New York Notes.

NEW YORK, June 13.—There have been no new developments in the Rapid Transit Commissioners' plans during the week. They have not finished their work, and were really unable to do anything of moment. Boring goes on steadily along Broadway under the supervision of the engineers. Fifteen men are at work all the time. When they report, possibly within a week, it is expected that they will show what amount of work will be necessary on the underground road. A good deal of speculation was indulged in by interested persons as to the relative cost of a viaduct or an underground line. Mr. Steinway says the underground will be built at very little additional cost, and that when completed it will give real rapid transit for a century. The road on stilts cannot, it is said, be so constructed as to allow trains to run faster than twenty miles an hour, while the board is determined to have express trains on the new road go at the rate of at least forty miles an hour. "The real question," said Mr. Steinway, "is whether twenty miles will be as satisfactory as forty miles in the same time. It may suit some who can be whisked to their offices in fifteen minutes to take a train which requires two or three times that time, but I am of the opinion that a majority of travelers will take the faster route."

Litigation over accumulator patents has been renewed, this time between the Brush Electric company and the Accumulator company. The patents have been in court before in the suit of Brush against the Julien company and were sustained. In the present case, however, the defense claims to be making a fuller defense than was made in the Julien suit, and many prominent experts have been engaged by both sides to testify. It is expected that the suit will end the enormous litigation over the storage battery system, which compelled the Fourth avenue line to withdraw its electric cars, and storage battery traction will be resumed on an extensive scale.

James E. Minnaugh has been convicted of murder in the first degree, and will be sentenced to death next week under the electrical execution law.

The first class to receive the degree of electrical engineer from Columbia College graduated at commencement, June 10th. The men who were granted this new degree are Gano S. Dunn, B. S, Wm. H. Freidman, C. E., Arthur S. Ives, C. E., Joseph T. Monell, C. E., and Robert B. Owens. These men are post graduate students, having first obtained a thorough collegiate education and then taken a two-year course entirely devoted to strictly electrical engineering work, uninterrupted by other studies, a plan which is found to give most excellent results.

J. L. B.

Denver, Colo.

DENVER, Colo., June 6.—A proposition has been submitted by the Denver-Highlands Electric company to furnish this city with arc lights at a cost, it is said, of $9.80 per month. Incandescent lights are also offered at $ 007 an hour for each light. The present price is one cent an hour. The matter will probably soon be acted upon by the council. The new company will meet with strong opposition, but the gentlemen interested are prepared to make a fight.

It is expected that the Colfax Avenue Electric company will soon extend its line to the gates of Fairmount cemetery. Donald Fletcher, the president of the company, approves the proposition.

South Denver's rapid transit facilities would be greatly increased by the proposed extension of the Pennsylvania line. It is rumored that the next franchise issued by the town board of South Denver will be to the Denver Tramway company for that purpose.

The Consolidated Electric Light company has made the following proposition to the city for municipal lighting: "An imaginary circle is to be drawn, with the center at the corner of Sixteenth and Curtis streets, and with a radius of one mile. All lights within this district are to be run on the all-night and every-night schedule, and are to cost the city $12 50 each per month. The present price is $14.50 per month.

"Outside of the circle named all territory that is not now covered by arc or incandescent lights is to be filled in by arc lights, run on the moonlight schedule at $10 per month. The arc lights now in place outside the mile limit to be lighted on the moonlight schedule at $10 per month.

"Whenever such new lights displace two incandescent lights the city is to pay the expense of making the change. On the other hand when it is 'new installation' the entire expense is to be borne by the company. All arc lights are to be the standard 2,000 candle power."

Pueblo will soon have another electric car line. Contracts have been signed by the Pueblo city railway officials for the east side line, and the work will be pushed forward without delay. C. S. Sauerland has been engaged in the enterprise. The road will be three and one-half miles in length. General Manager J. B. Downey of the railway company thinks he can complete the road within six weeks.

E. C. D.

Indianapolis, Ind.

INDIANAPOLIS, Ind, June 13.—City Engineer Mansfield has just completed his map showing the location of the lamps necessary to properly light the city. He says that750 arc lights will be sufficient. Specifications are also prepared for new bids for putting in the necessary plant.

The new Broad Ripple line, which the Edison company is building, is now well under way. On Wednesday, however, the sub-contractor received notice to stop work of all kinds for the present. There are rumors of a deal between the Edison company and the Citizens' Street Rail way company, whereby all material will be transferred to the latter company and the Edison company complete the work for it. This, is desired by both the Broad Ripple company and the Citizens' company. The Citizens' company is pushing work on the Irvington line. All the material is on the ground. A duplicate of the machinery already installed at the power house has been received and is being put in position. This will make two 150 horse power engines, with the necessary boilers, and six generators. It is quite certain that the company will transform the College avenue route into an electric line as soon as material can be secured. The company has asked the board of public works for the right to extend the line about a mile north of the present terminus and the county commissioners for the right of way beyond the city limits, to make connection with the Fairview line. This company has also requested the right to build an electric line to North Indianapolis. In opposition to this a company composed of several wealthy Cincinnati gentlemen has asked for the right of way and a franchise to build an electric line from the union station to North Indianapolis and thence to Fairview Park and Broad Ripple, it having secured an option on the tow-path of the old canal for the entire distance. This company asserts that if sufficient encouragement is given it will begin work immediately and erect a first-class line.

M.

PERSONAL.

J. Stanford Brown has opened an office at 611 and 612 Electric exchange, New York, as a consulting electrical engineer.

D. B. Dean of the Electric Merchandise company, Chicago, is making a trip through the Pacific coast region looking up the street railway interests in that section.

W. P. Upham has been appointed assistant to Electrical Engineer E. C. Noe to take charge of the city work for the western department of the Thomson-Houston company, Chicago.

W. D. Packard, secretary and treasurer of the Newport & Ohio company, Warren, O., was married on Thursday, June 11, at Middleton, Conn., to Miss Anna N. Stohrer. Mr. Packard and his bride will enjoy a two weeks' visit at Chautauqua Lake and then return to Warren, where they will reside.

C. A. Daigh, president, and Morgan Brooks, treasurer, of the Electrical Engineering and Supply company, 931 Rookery, Chicago, have just returned from an extended eastern trip made in the interest of the National Electric Manufacturing company and other corporations represented by this company.

NEW INCORPORATIONS.

Dederick Motor company, Milwaukee, Wis.; capital stock, $250;000; manufacture and sale of motors.

Wisconsin Gas & Electric company, Superior, Wis.; capital stock, $250,000; operating gas and electric systems.

Miller Electric Danger Signal company, Portland, Me., capital stock, $100,000: to manufacture and equip railroads with electrical devices.

Lincoln Electric Railway company, Lincoln, Neb.; capital stock, $200,000; to build and maintain an electric railway in Lincoln, Neb.

Greenwich Electric Light & Power company, Greenwich, N. Y.; capital stock, $15,000; manufacturing and producing electricity for light, heat and power.

Alexandria Bay Electric Light & Power company, Alexandria, N. Y., capital stock, $7 500; manufacturing and using electricity for light, heat and power in the town of Alexandria.

Lake Superior Engineering & Construction company, Marquette, Mich.; capital stock, $200,000; buying, selling, dealing in and manufacturing mechanical and electrical implements, tools, apparatus, etc.

Santa Cruz, Garfield Park & Capitola Electric railway, Santa Cruz, Cal., capital stock, $100,000; the construction, maintenance and operation of an electric railway and electric street railway in the city of Santa Cruz and in the county of Santa Cruz.

ELECTRIC LIGHTING.

Vallejo City, Cal., has introduced electric lighting.

An electric light plant will be established at Newton, N. C.

It is reported that Rosedale, Miss., will introduce electric lighting.

The people of Ozark, Ala, are talking of putting in electric lights.

The erection of an electric lighting plant in Greenville, Ala., is contemplated.

A project is on foot for the installation of an electric light plant in Georgetown, Texas.

Six hundred electric lights illuminate the interior of the new Jewish temple of Kehilath Anshe Maariv in Chicago.

A company has been organized to erect an electric light plant and introduce other improvements in Asheville, N. C.

The Edison Electrical company of Oakland, Cal., has purchased the plant and franchises of the Oakland Electric Light and Motor company.

The splendid new Hamburg-American steamship Fuerst Bismarck, which made the fastest maiden trip on record last month, has a complete electric equipment. The lighting plant comprises four sets of combined engines and dynamos, the latter being compound wound and of Siemens' latest type. A thousand Edison 25-candle power incandescent lamps illuminate all parts of the ship.

ELECTRIC RAILWAYS.

Paris, Tex., is to have an electric railway built by the Paris Gas & Electric company.

A company has been organized at Fort Dodge, Ia., for the purpose of constructing an electric street railway.

The contract for equipping the new power house of the Rivermont company at Lynchburg, Va., has been awarded to the Edison General Electric company.

The extension of the electric street car system in Rochester, N. Y., is proceeding rapidly. The new cars will soon be running on the Exchange and Hudson street, North St. Paul street and North avenue routes.

The Illinois Electrical Material company of Chicago, in conjunction with C. H. Holmes of St. Louis, has secured the contract for the supplies and construction of the overhead work on the Cairo street railway.

A scheme for an underground railway in Berlin has been submitted for approval by the directors of the Poetsch mine and foundry engineering works at Magdeburg. The railway will be operated either by electricity, atmospheric pressure or hydraulic pressure. The projector of the work intends to sink the 60 entrance shafts which are required, by a method he has himself devised.

ELECTRIC MOTOR.

An Atlanta business man is negotiating for the establishment at Fort Worth, Texas, of a plant for the manufacture of electric motors.

The C. & C. Motor company, New York, has equipped the White House at Washington, D. C., with a complete outfit of electric ventilating fans.

The *National Incorporation Reporter* announces that during the first four months of the year there were 5 205 actual incorporations in the country. The total capitalization was $2,150,683,571, distributed as follows: 2,434 mercantile and manufacturing companies, $419,007,000; 394 gold, silver and other mining and smelting companies, $348,737,900; 120 coal and iron companies, $44,761,550; 217 banks and investment companies, $23,522,300; 368 municipal, light, heat, power and transportation companies, $68,962,000; 238 building and loan associations, $868,985,480; 1,427 miscellaneous, $284,289,386. It will be noticed that light, heat, power and transportation incorporations were quite prominent in this list.

ELECTRIC MINING.

George Cutter is furnishing large quantities of simplex mining wire for use in underground plants where the conditions are very trying to insulation. He is also building some special switches and cut-outs for use in mines and other damp places, so that he will soon have a full line of special devices for mine plants.

The Seattle, Wash., papers report that an electrical coal hoist has been installed at the Black Diamond coal mine. The hoisting machine has been placed at the top of a slope 450 feet in length, at a spot 3,100 feet from the mouth of the mine. The generator which supplies the motor attached to the hoist has a capacity of 120 electrical horse power, and is located at the mouth of the mine, while the motor is rated at 80 horse power. When a test was made 12,000 pounds of coal was hoisted at one trip up the slope in one and one-half minutes.

In the course of an article on the "Progress of Electricity in Mining" *Black Diamond* says: "Although it is but a few years—three or four at the most—since electricity was permanently introduced into the coal mines of this country, not only for light, but, what is far more important, in so far as it is more generally applicable, as a motive power, to day that great power, chained and made to do the will of man to a most wonderful degree, has become a dominant factor in furnishing the force to operate coal cutters, drills, underground haulage, pumps, ventilating fans, and, in fact, almost everything connected with the apparatus necessary at a well-equipped mine."

TELEGRAPH.

One of the items of revenue from the Brooklyn bridge is $13 000 annually paid in rentals by telegraph and telephone companies.

The laying of an Atlantic cable between Spain and the island of Porto Rico is again under discussion. The Spanish minister of colonial affairs has stated that he is considering the conditions on which to invite bids.

There is a project for laying a new submarine telegraphic cable from Pernambuco, in Eastern Brazil, to a point on the western coast of Africa. The Brazilian government favors the project, and has granted a concession to the British syndicate formed for the purpose of conducting the enterprise.

The statement of the Western Union Telegraph company for the quarter ending June 30th, partly estimated, shows: Net revenue, $1,500,000, a decrease of $250,000; surplus, April 1, $11,148,376, an increase of $1,557,460; total, $12,648,376, an increase of $1,307,460; interest and sinking fund, $242,898, a decrease of $245; balance, $12,405,478, an increase of $1,307.705; dividend, 1¼ per cent., $1,077,395; surplus, $11,328,078, an increase of $1,307,701. The gross earnings of the Western Union for telegraph service, as for previous quarter, have continued to show satisfactory increase, being about $300,000 in excess of same quarter of last year, while the rental of private wires, the rental of offices in the company's buildings, commercial news service and other incidental revenues have fallen off. But, as shown for previous quarter, and for the same reasons, the expenses have been extraordinarily increased, and the net results are, therefore, somewhat below the estimate.

TRADE NEWS.

The Midland Electric company, Denver, Colo., has removed from 1517 and 1519 Larimer street to new and commodious quarters at 1616 and 1618 Seventeenth street.

J. W. Mason, formerly with the Gate Gity Electric company, has opened an electric supply house at Kansas City, Mo. Mr. Mason was president of the Gate City company over two years. He is well known in telephone circles, having been identified with the telephone interests in Michigan. He has equipped his headquarters with a complete line of electrical supplies, and expects an excellent opening trade.

The Triumph Compound Engine company of Cincinnati, O., reports orders for their valveless compound engines as follows: Reading, Pa., 3, 125 horse power; Natrona, Pa, 1, 80 horse power; Rochester, N. Y., 1, 80 horse power; San Francisco, 2, 60 horse power; Richmond, Va., 2, 55 horse power; Hamlet, Ga, 1, 50 horse power; Covington, Ky., 1, 30 horse power; St. Louis, Mo., 1, 30 horse power; Natrona, Pa., 1, 15 horse power; Bardstown, Ky., 1, 15 horse power; St. Louis, Mo., 1, 15 horse power; Laurens, S. C., 1, 15 horse power; making a total of 570 horse power.

It may not be generally known that the Electrical Supply company has its business divided up into some 10 or 12 departments, each one of which is under the direct control of a manager who is held responsible by the general manager for his department. One of the principal departments is that pertaining to house goods which includes electric bells, electric batteries, annunciators, burglar alarms, chemicals, push buttons, annunciator wire and all the various supplies and appliances which are required to fit up hotels or dwelling houses with all the modern electric devices, aside from electric lighting. The latter branch is controlled by the electric light and power department.

The Falls Rivet and Machine company of Cuyahoga Falls, O., which furnishes all the intermediate mechanism necessary for the transmission of power from the engine to the generator, has recently opened an office at No. 8 South Canal street, Chicago, with F. W. Weir in charge as general Western manager. This company has just secured the contract for fitting up the large plant in the new Masonic temple in Chicago, and is also equipping a new plant for the Louisville Electric Light company. Other electric light and power plants fitted up by the Rivet company are those of the Cincinnati Street Railway company, the Covington, Ky., Electric Street Railway company, Belt Electric Railway company of Lexington, Ky., and electric light companies at Put-in-Bay, O., and Marion, Ind.

The Easton Electric company, New York City, is the sole manufacturer of the Easton arc dynamos, new Universal arc lamp for arc and incandescent circuits, and the Easton incandescent dynamos, generators, motors, etc. Plants are installed at Rockland, Me.; Elmira, N Y.; Lynchburg, Va.; Newark, N. J; Brooklyn, Whitehall and Coney Island, N.Y.; Denver, Colo.; Chicago, Ill.; Milwaukee, Wis.; Burlington, Ia.; Reading, Pa.; Birmingham, Ala; Milledgeville, Ga.; Eureka, Kan.; Lee, Mass., and Lakeland, Fla. The factory of the company is in Brooklyn. N.Y., occupying two floors of a large substantial brick building on Kent avenue, between Keap and Hooper streets. The establishment is in charge of William D. Perry, vice-president of the company. Two Easton incandescent dynamos have recently been sold; one, a 100-light incandescent machine to the Brooklyn Annex line, making three used on these boats, and a 250 light machine to the new sound steamer, General Slocum.

These are the days when the business man's fancy lightly turns to thoughts of electric fans. In doing so he can hardly fail to consider the C. & C. fan outfits, the merits of which are attractively set forth in a neat little pamphlet just issued. Here we are reminded that "these little machines, occupying a space of something less than a cubic foot, will keep any room of ordinary size at a pleasant temperature through the hottest summer weather. Their operation is unattended with danger; they can be moved into any desired position in a room; the power required to drive them is about the equivalent of that needed for one incandescent lamp, and the cost for current is approximately the same. The only pre-requisite to their use is that electric current shall be available either from the street wires, from a dynamo on the premises, or from a storage battery." The C. & C. Electric Motor company has also just perfected a 500-volt fan outfit, designed for electric railway circuits. The Chicago office is in the Phenix building.

The establishment of the Crocker-Wheeler Electric Motor company, West Fourteenth street, New York City, has been enlarged, and the alterations which have been going on for some time in the old portion of the works have baen completed. Access to the company's quarters is now furnished by a new entrance on West Fourteenth street. The staircase leads to the exhibition room, which is well lighted and neatly finished in hard wood. Ventilating fans, operated by Crocker-Wheeler motors, add to the comfort of the occupants and visitors. A number of motors, 1-12, 1-6, 1-8, 1-4, 1 2, 1, 3 and 5 horse power, are exhibited in connection with electric disk ventilating fans, electric pumps, etc. An interesting exhibit is a 1 6 horse power motor, which runs a Wheeler & Wilson sewing machine. Other applications exhibited are a 1-2 horse power motor driving a 2x1 3-4 inch triplex pump, and a 1-6 horse power motor driving a 1¼x2 inch triplex pump. In the exhibition room on a long table are also shown the several parts of the Crocker-Wheeler motor. To the right of the exhibition room comes first the office of Prof. F. B. Crocker and S. S. Wheeler—a pleasant, well-lighted and cosy room, nicely furnished with polished oak desks, chairs and other necessary office fixtures. Next are the quarters of the secretary and general sales agent of the company, Geo. W. LaRue, from which communication is had with the general business office and drawing room in charge of W. H. Geers, the assistant secretary. The shops and testing rooms are located to the left of the exhibition room, and run the entire length of the block between West Fourteenth and West Thirteenth streets, and are fitted throughout with the finest machinery obtainable, necessary for the company's manufactures. The Crocker-Wheeler Electric Motor company employs about 150 hands, who find the new quarters a great improvement over the old establishment.

The Thomson-Houston Electric company reports recent sales of lighting apparatus as follows, the number of lights being appended in each case: Arc apparatus—Athens, O, 18; Braintree, Mass, 30; Chehalis, Wash., 30; Bridgeport, Conn., 45; Portland, Me., 45; Brooklyn, N. Y., 90; Narragansett Pier, R. I., 30; Harrison, O., 35; Ashland, O., 70; Findlay, O., 45; Springfield, Vt., 35; Anderson, Ind., 50; Salem, Va., 100; Athol, Mass., 25; Poughkeepsie, N. Y., 50; Beverly, Mass., 100; N. Tonawanda, N. Y., 100; Lancaster, O., 50, Corning, N. Y., 50; Camden, N. J., 50; Lexington, Ky., 50; Catlettsburg, Ky., 50; Lockport, N. Y., 50; Noblesville, Ind., 50; Clinton, Ia., 50; Parkersburg, W. Va., 100; Lincoln, Neb., 150; Washington, D. C., 100; Put-in-Bay, O., 50; Bay City, Mich., 100; Syracuse, N. Y., 50; Newton, Mass., 50; Columbus, O., 50; Covington, Ky., 50; Newark, N. J, 100; Elwood, Md., 50; Key West, Fla., 50 Oakland, Cal., 50. Incandescent apparatus—Narragansett Pier, R. I., 1,300; Springfield, Vt, 650; Salem, Va., 1,300; Newton, Mass., 650; Key West, Fla., 1,950; Titusville, Fla., 400; New Haven, Conn., 400; Bay Shore, L. I., 400; Denellin, N. J., 300; Shawnee, O., 300; Akron, O., 1,300; Camden, N. J., 1,300; Brooklyn, N. Y., 1,300; Lock Haven, Pa., 1,300; Iron Mountain, Mich., 1,950; Buena Vista, W. Va., 1,300; Norwalk, Conn., 1,300; Lexington, Ky., 1,300; Atlanta, Ga., 1,300; Waltham, Mass., 1,300; Tacoma, Wash., 2,600; Morristown, Tenn., 650; White River Junction, Vt., 650; New London, Conn., 650; Patchogue, L. I., 650; Martinville, Md., 650; Princeton, Md., 650; Bedford City, Va., 650; Millersby, O., 650; Wilton, Mass., 650; Cohasset, Mass., 650; Catlettsburg, Ky., 650; Waco, Tex., 1,950. Isolated arc plants—Aluminum Carbon company, Lancaster. Pa., 6; U. S. Immigration Depot, Ellis Island, N. Y. Harbor, 40; Palisades Amusement company, 150. Isolated incandescent plants—H. K. Hartzell, Catasauqua, Pa., 50; Fort Hamilton Brewing company, Fort Hamilton. N. Y., 50; Bradbury-Stone Storage Battery company, Lowell, Mass., 100; National Transit company, Parkers Landing, N. Y., 100; E. Copeland, N. Y., 100; Henry Adams, Rockville, Conn., 150; Cutler Bros., Wakefield, Mass., 150; Blue Ridge Inn, Mt. Airy, N. Carolina, 200; Wainwright Real Estate company, St. Louis, Mo., 2,000; Agnes Scott Institute, Decatur, Ga., 200; Croton Magnetic Iron Mine, Brewster, N. Y., 300; H. C. F. Koch, New York, 800; W. Engle & Co., Orono, Me., 50; Cleveland Ship Building company, Cleveland, O., 100; Consumers' Brewery company, New York, N. Y., 400; Manufacturers' Investment company, Madison, Me, 400; A. O Couch, New York, 200; W. E. Anderson, Blacksburg, Va., 400; Washington Loan and Trust company, Washington, D. C., 800.

BUSINESS.

A handsome new catalogue extolling the merits of the Jenney electric motor is out.

F. A. Magee, M.E., has taken charge of the Boston office of the Engineering Equipment company and the Underwood Manufacturing company.

The Denio Auxiliary and Automatic Fire Alarm Button, manufactured in Rochester, N. Y., is a new thermo electric device by which the melting of solder at a certain temperature closes an electric circuit and rings an alarm.

The New York and Ohio company at Warren, O., is having an unusually active business for this season of the year. It is now making a thousand Packard lamps daily, and will soon commence building an addition to the factory, 40x60 feet, and two stories high, which will more than double its capacity, enabling the company to make from 2,500 to 3,000 lamps per day.

The Continental Electric Construction company, room 1118 Chamber of Commerce building, Chicago, has under contract at Battle Creek, Mich., an electric street railway eight miles in length, to be equipped with the Short system, and another, its exact counterpart at Beatrice, Neb. This company has recently been organized for the purpose of building electric railways and doing a general electrical contract business, and has met with marked success.

At a meeting of the stockholders of the Buckeye Electric company held in Cleveland, O., June 1st, the capital stock of the company was increased to $250,000, and the management was instructed to at once proceed to the erection of new buildings giving the plant a capacity of 5,000 incandescent lamps per day. The plans are now being prepared and when completed the buildings will be built on the site of the present factory on East Broadway. It is expected that ground will be broken about July 1st and the buildings pushed to completion as fast as possible.

ELECTRICAL PATENTS.

Issued June 9, 1891.

453,608. Electric Cigar Lighter. Harrison B. Brown, Washington, D. C.

453,633. Electric Switch. Lawrence F. Furlong and Frederick O. Tucker, Hartford, Conn.

453,681. Electrical Measuring Instrument. Frank C. Wagner, Ann Arbor, Mich.

The invention consists in the combination of two substantially similar and equal wires fixed at their extremities and connected at their middle points by links to a pivoted pointer, and a scale over which said pointer moves.

453,693. Electric Arc Lamp. Josiah W. Ells, Pittsburg, Pa.

453,695. Secondary Battery. William W. Griscom, Haverford College, Pa.

453,696. Engine Indicator for Steam Vessels. William E. Hadlock, Wenham, Mass.

453,710. Electric Railway. John Jones, New York, N. Y.

The first claim is given:

"In a crossing bridge for trolleys the combination, with the conductor for one line of two track arms pivoted thereto, one of said arms having a bifurcated end adapted to receive the end of the other arm, and a link connection between the two arms."

453,722. Attachment for Telephones. Edward E. Baker, Pittsburg, Pa.

453,723. Electric Fire Alarm. Michael M. Braun, Allegheny, Pa.

453,733. Electric Conduit. John E. Price, Denver, Colo.

453,742. Manufacture of Incandescent Electric Lamps. Reginald A. Fessenden, Roseville, N. J.

The process consists of exhausting the air from the bulb and then fusing the glass to the oxidizable conductors.

453,822. Commutator. Elmer A. Sperry, Chicago, Ill.

The first claim reads as follows:

"A commutator for a dynamo or motor containing an elastic medium to relieve the insulation from compression strains due to the expansion or contraction of the parts."

453,858. Commutator for Dynamo Electric Generators and Motors. Henry Davis and Arthur H. Stokes, Derby, England.

453,861. Marine Torpedo. Nicholas J. Halpine, U. S. Navy.

453,863. Distributing Frame for Electric Conductors. Angus S. Hibbard, Morristown, N. J.

453,871. Lighting of Tables and the Like by Electricity. Oscar H. Stovell, Hampstead, England.

453,888. Electric Switch. Willis Mitchell, Malden, Mass.

453,898. Electric Battery. Jacob O. Brinkerhoff, Hackensack, and Milton E. Smith, Rutherford, N. J.

453,950. Secondary Battery Element. John H. Walter, Washington, D C.

453,982. Fire Alarm Telegraph. George F. Milliken, Boston, Mass.

453,993. Non-Interference Signal Box. Frederick W. Cole, Newton, Mass.

453 995. Secondary Battery. Stanley C. Currie, Philadelphia, Pa.

454,008. Supporting and Connecting the Driving Motors of Electric Cars. Sidney H. Short, Cleveland, Ohio.

The invention consists of the combination, with a car, of one or more propelling motors with axially mounted and directly connected armatures, and the field magnet supporting frame journaled on and depending from the car axles.

454,016. Metallic Circuit Test and Time Signal for Telephone Exchanges. Joseph J. O'Connell, Chicago, Ill.

The invention consists in inducing vibratory currents upon the metallic circuits by means of a primary winding upon the cores of the individual annunciators, battery, and a rheotome, and preferably resistance being included in the primary circuit, the metallic circuits being each provided with a single branch circuit to ground at the subscriber's station thereon.

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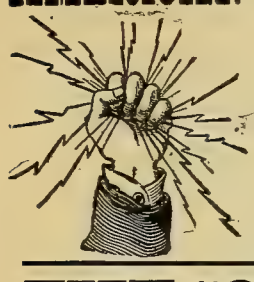

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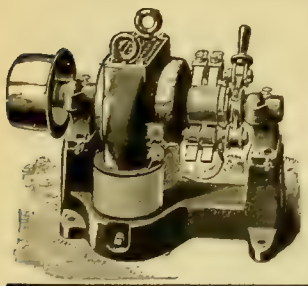

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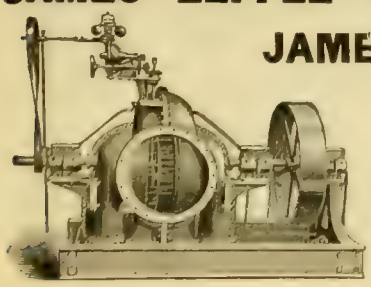

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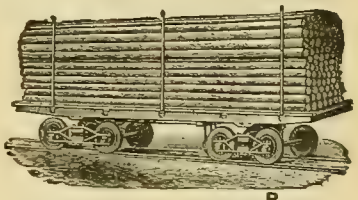

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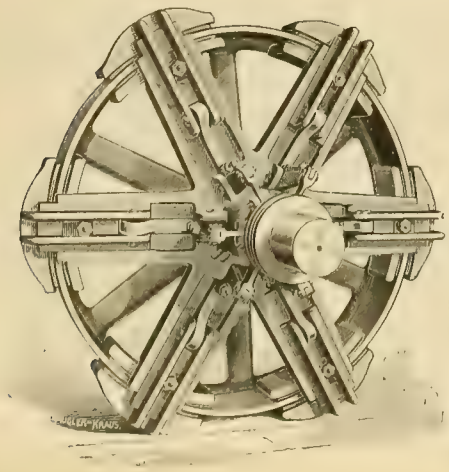

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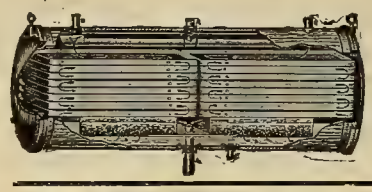

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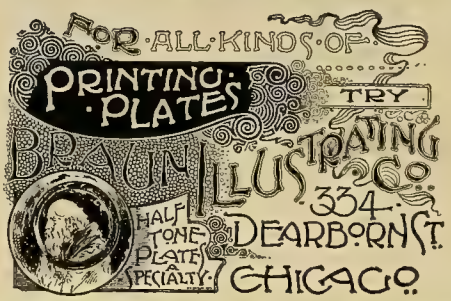

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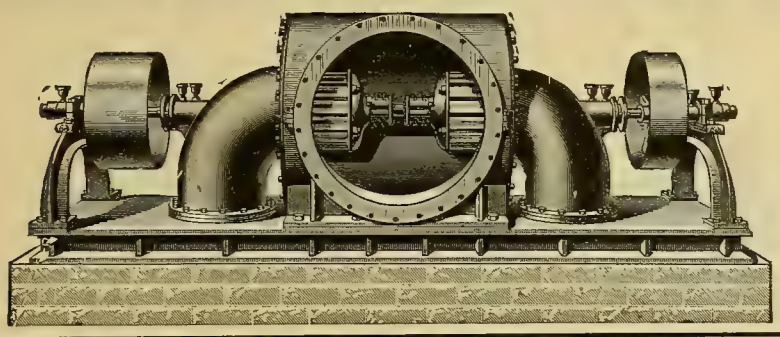

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MINING AND SPECIAL MACHINERY.
MANUFACTURERS' AGENT.
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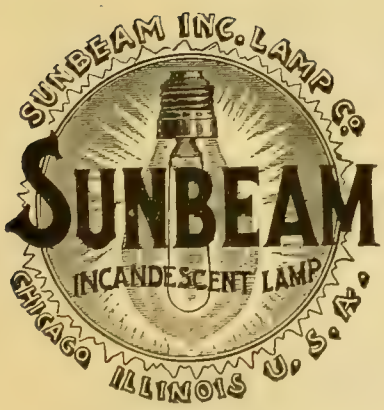

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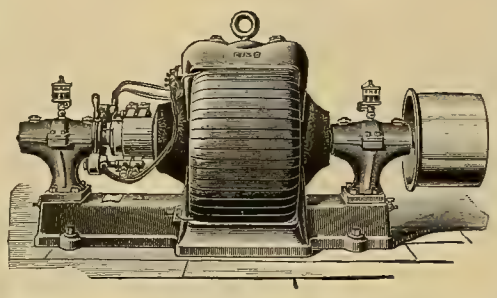

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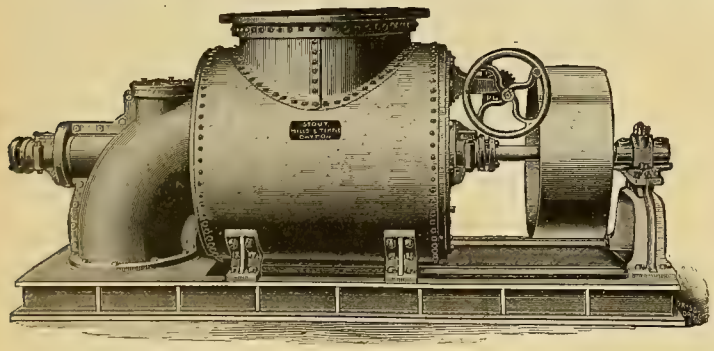

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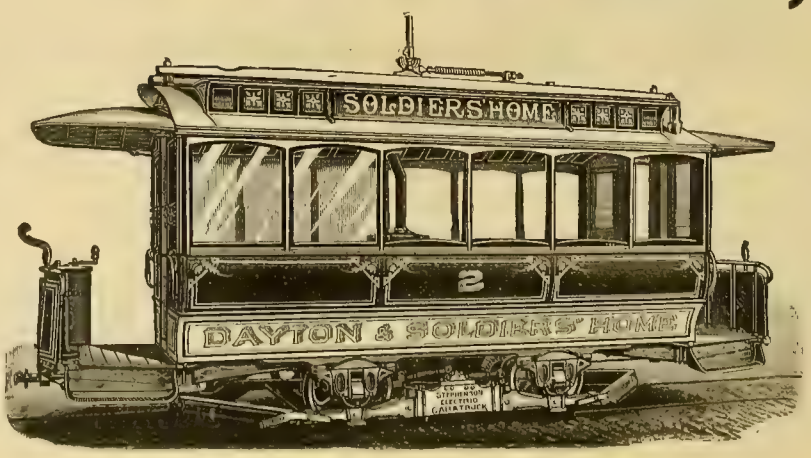

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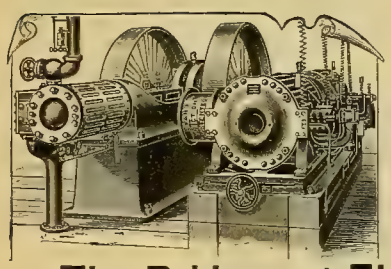
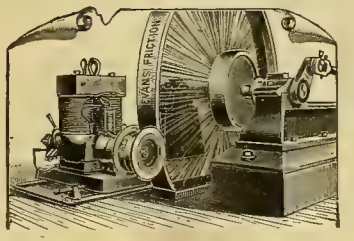

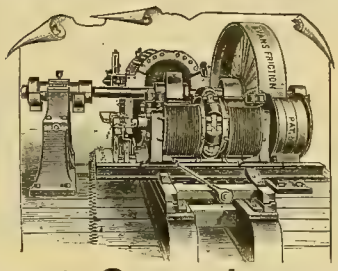

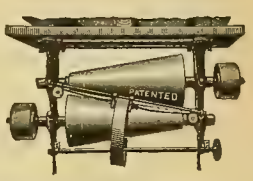

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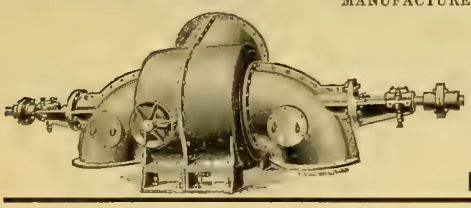

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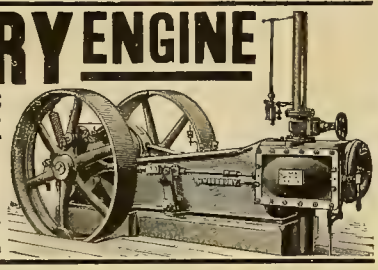

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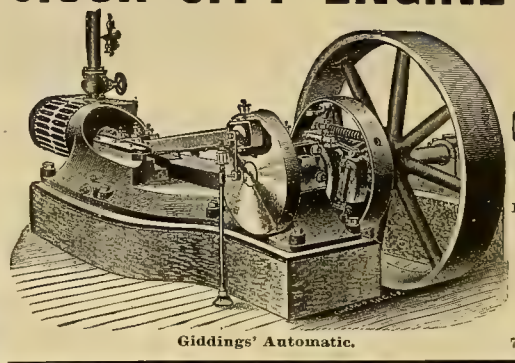

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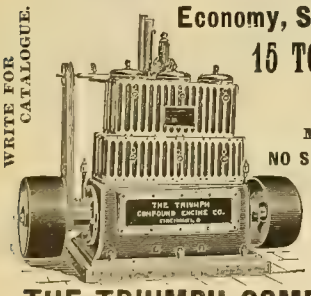

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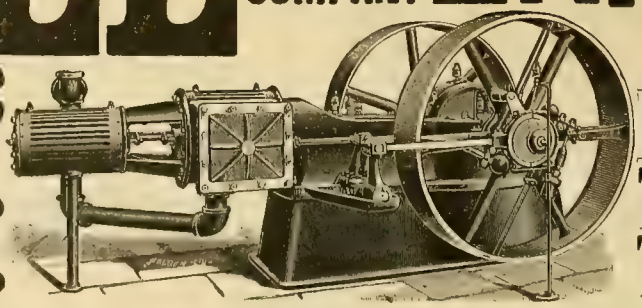

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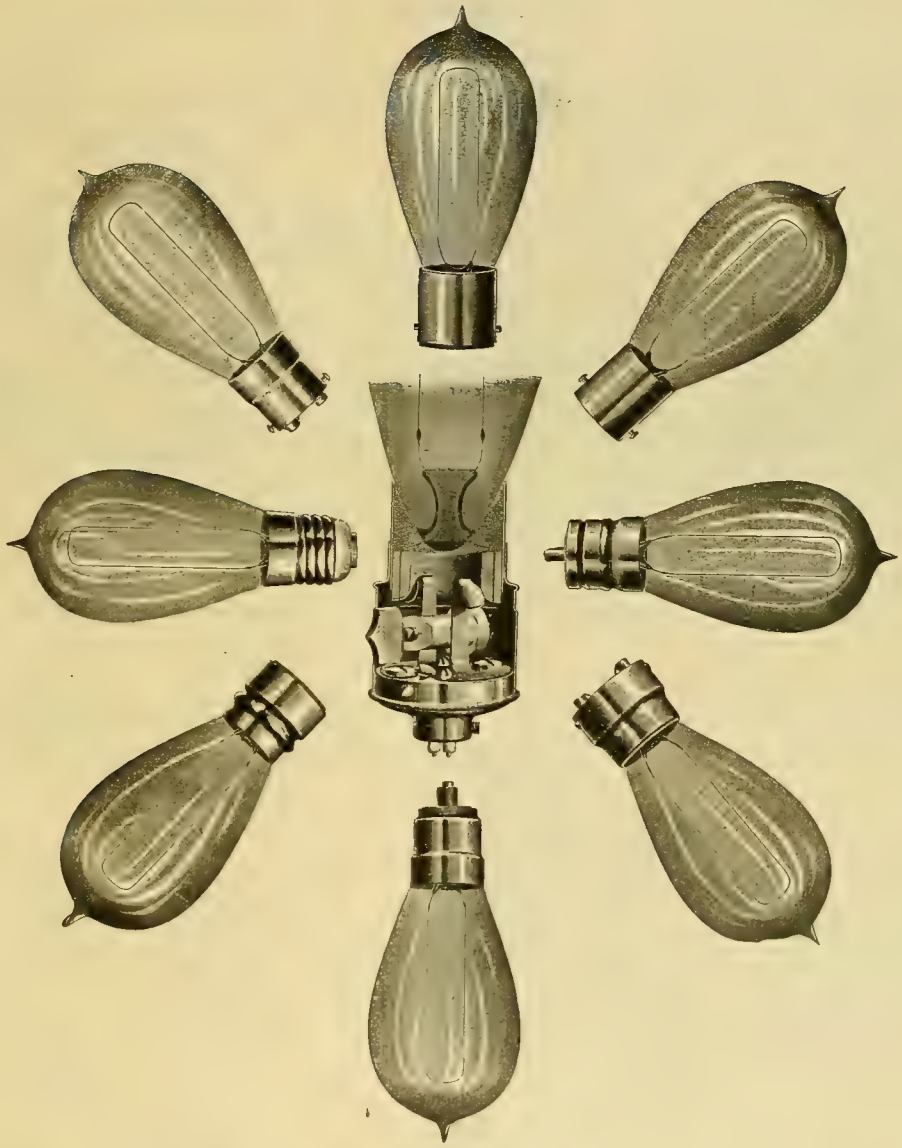

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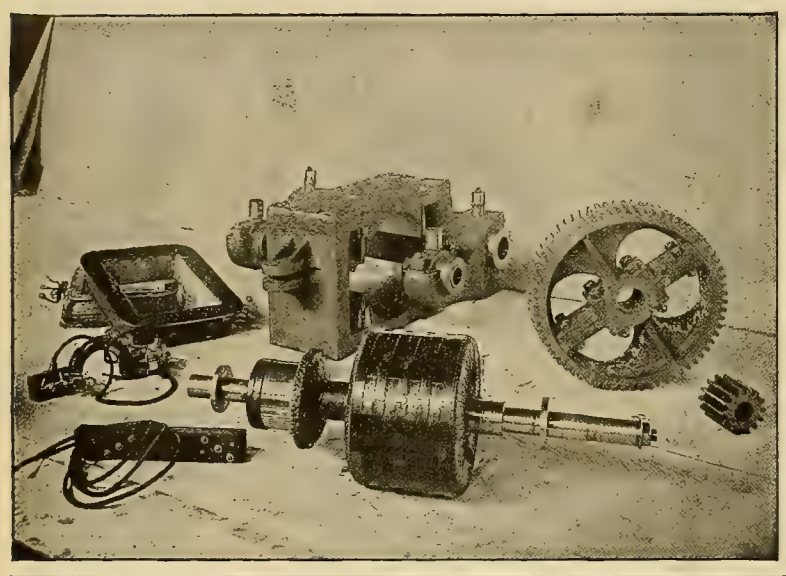

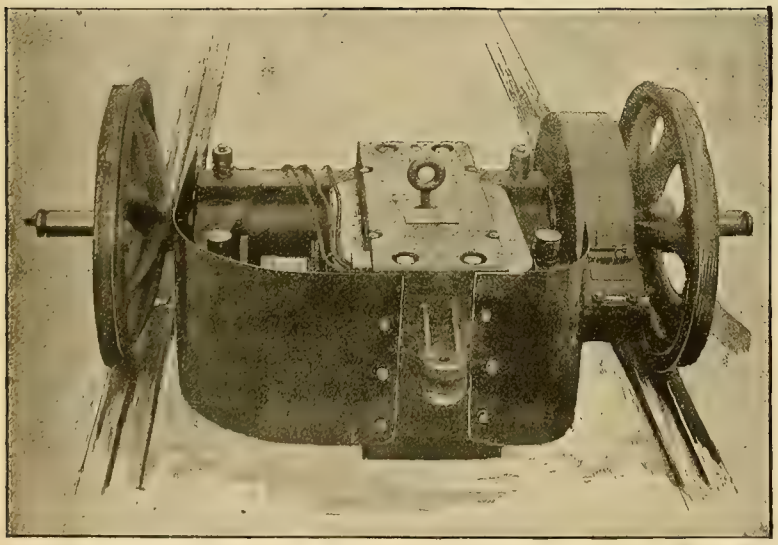

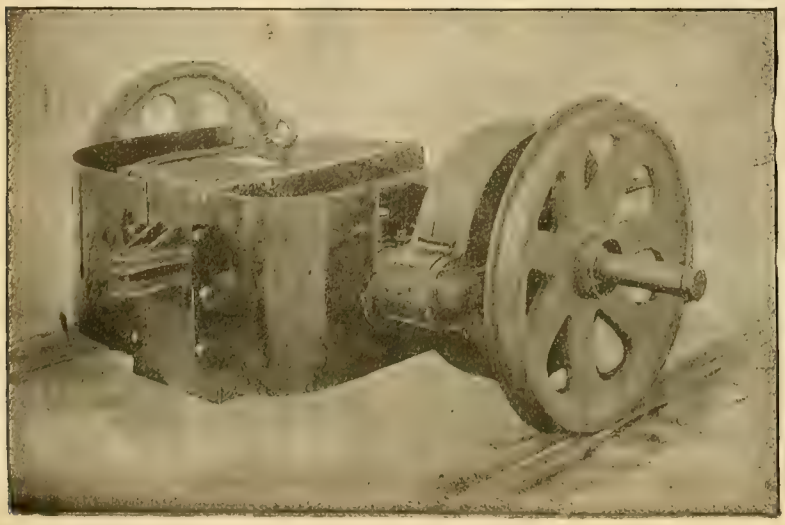

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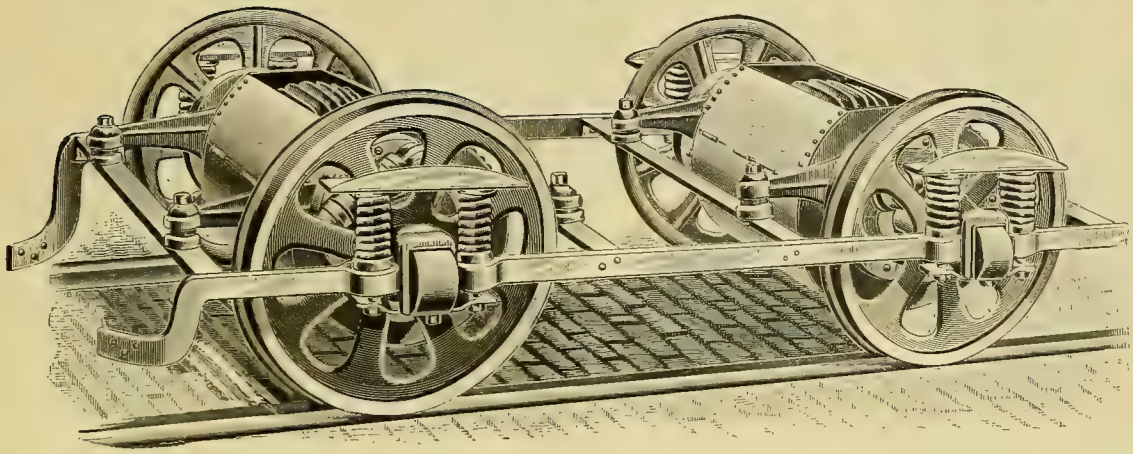

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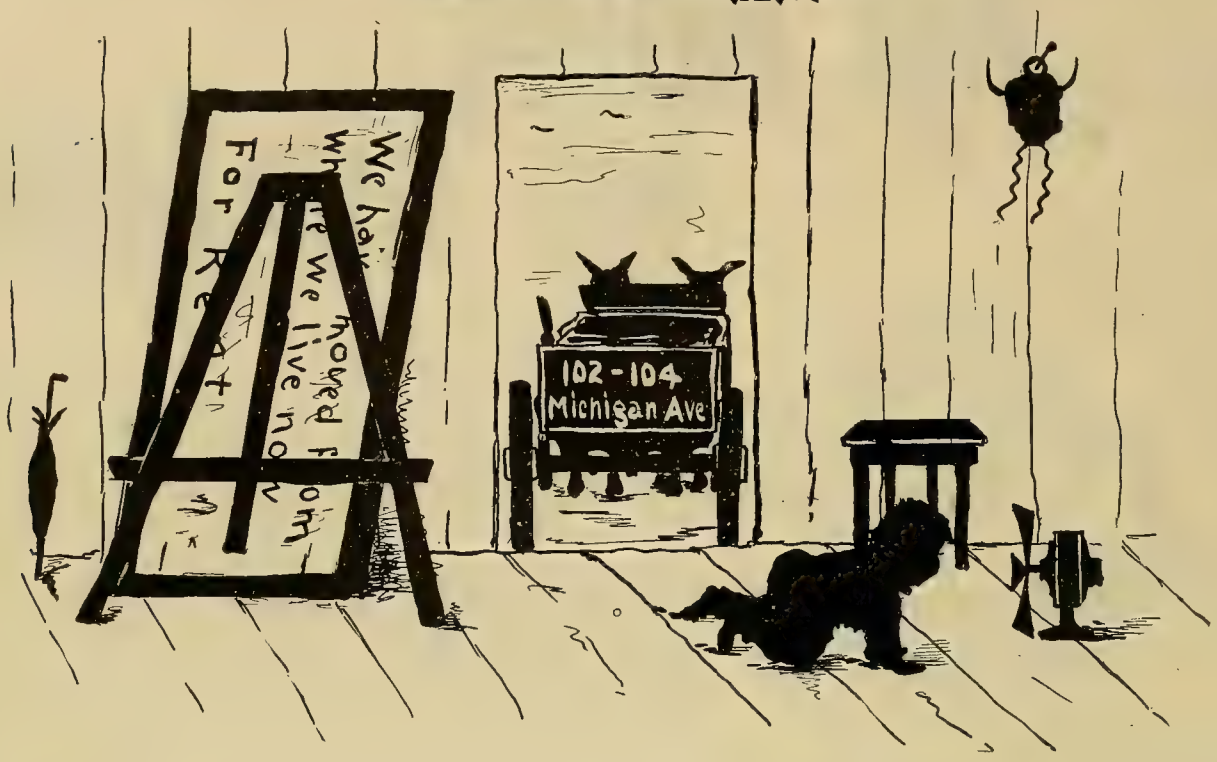

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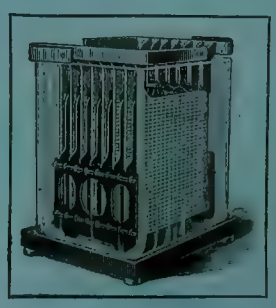

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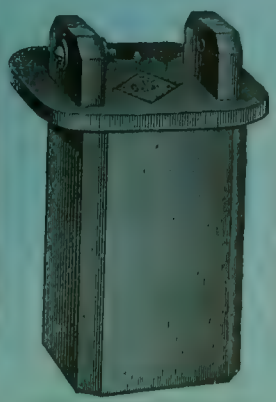
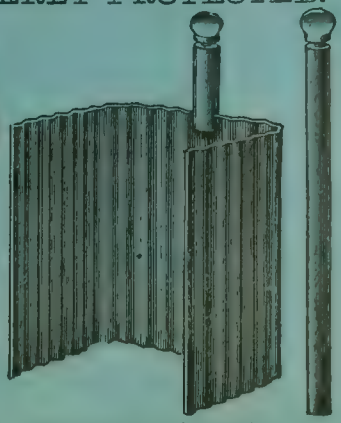


Carbon Reservoir and Cover of Champion Battery.



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NOTE THE CONTRAST!!

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4,150	VERMONT,	2,200
12,800	TENNESSEE,	1,485
1,500	SOUTH CAROLINA,	NONE.
18,450	TOTAL,	3,685

FIVE TIMES as many of the Thomson-Houston System as of

ALL OTHERS COMBINED.

The figures referring to "total of all systems," taken from table published in August number of "Electrical Industries," for year 1890, are of undisputed accuracy.	Total of all systems.	Thomson-Houston System.	
		Number.	Percentage to total of all systems.
Vermont, - - - -	6,350	4,150	$65\frac{3}{10}$ per cent.
Tennessee, - - - -	14,285	12,800	$89\frac{1}{2}$ per cent.
South Carolina, - -	1,500	1,500	100 per cent.

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405 Sibley Street, St. Paul, Minn.
215 West Fourth Street, Cincinnati, O.
1110 Noble Street, Philadelphia, Pa.
1333 F Street, Washington, D. C.
115 North 3d Street, St. Louis, Mo.

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Electrical Construction Co., The.
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GreatWestern Electric Supply Co.
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Monitor Electric Co.
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Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

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Turner Brass Works.

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Brush Electric Co.
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Queen & Co.
Stanley & Hall.
Western Electric Co.

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N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

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Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.
Pond Engineering Co.

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Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Turner Brass Works.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co.,The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
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Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Minneapolis St. Ry. Co.
Stephenson Co., John.

Clutches, Friction.
Hill Clutch Works.

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Bain Electric Mfg. Co.
Electric Construction & Supply Co.
Electrical Construction Co., The.
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Knapp Electrical Works.
McLaughlin, Jas.
Temple, J. C.
Western Electric Co.

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Chicago Electric Mfg. Co.
Easton Electric Co.
Edison General Electric Co.
Electrical Engineering Co.
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Engineering Equipment Co.
Hutton, Henry.
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United States Electric Lighting Co.
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Western Electric Co.
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American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
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Holmes, Booth & Haydens.
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Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Howard & Co., Hiram M.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
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Western Electric Co.
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Electrical Instruments.
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Partrick & Carter Co.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Specialties.
Northwestern Elect. Specialty Co.
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Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Engineering Equipment Co.
Pearson & Co., W. B.
Pond Engineering Co.
Sioux City Engine Works.
Stearns Mfg. Co.
Triumph Compound Engine Co.
Westinghouse Machine Co.

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General Electrical Supplies.
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Butler Hard Rubber Co.

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Butler Hard Rubber Co.
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Hunt Machine Co., Rodney.
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Knapp Electrical Works.
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PATENT "K.K." LINE WIRE

TRADE MARK "K.K."

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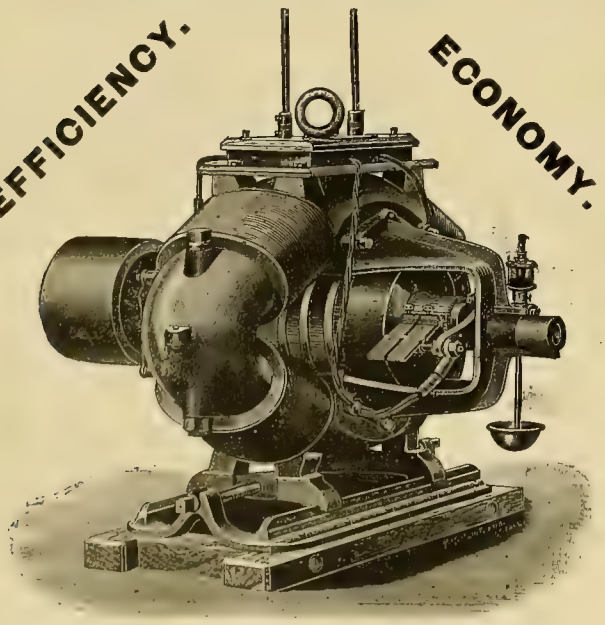
EFFICIENCY. ECONOMY.



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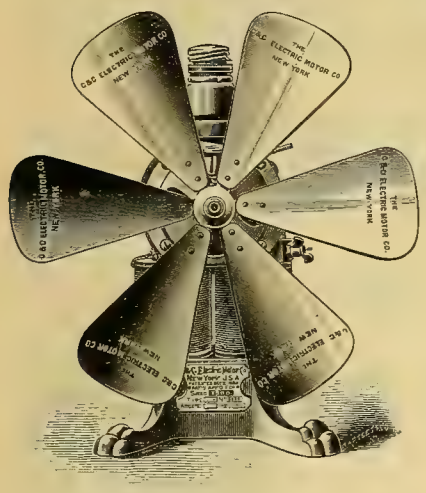
Northwestern Electrical Specialty Co.,

GENERAL WESTERN AGENTS,

1017 Chamber of Commerce, Chicago.

GEO. L. KIRKHAM, MANAGER.

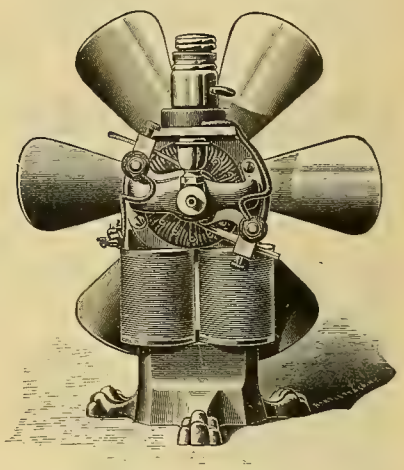
C. & C. FAN OUTFITS.



110 Volt Fan Outfit. Front View.

THE OLDEST AND BEST.

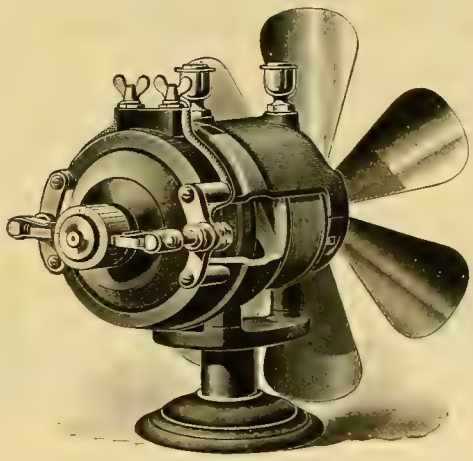
The season of 1891 marks the fifth year since the introduction of the C. & C. Fan Outfits.



110 Volt Fan Outfit. Back View.

Thousands in Operation in Every State and Territory in the Land.

With each season some improvement either Electrical or Mechanical has been made, until the Machine as placed this year on the market, is absolutely without defect.

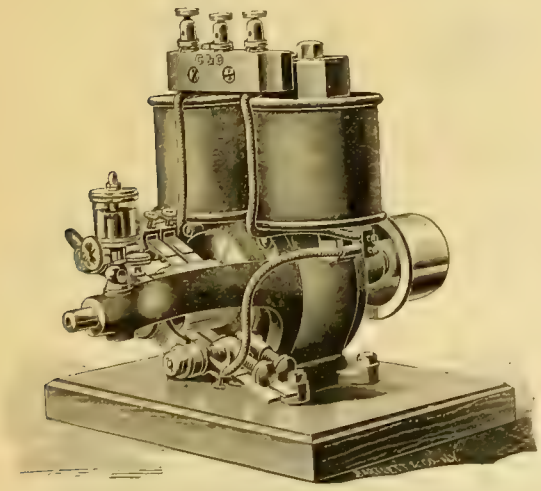


500 Volt Fan Outfit.

Wound for any direct current Circuit.

Finished in dipped brass, polished or nickeled.

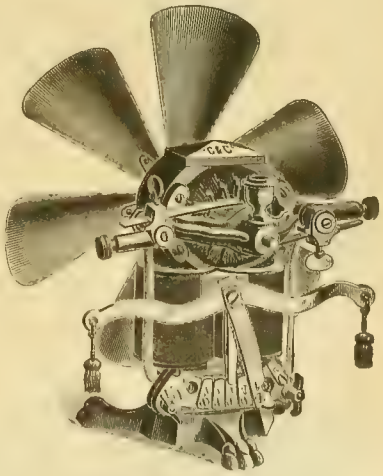
For Electric Railway and Power Circuits we are this year ready to supply a Fan Outfit designed especially for high Potential Circuits.



1-4 H. P. Motor for operating Ceiling Fans.

OFFICES:

BOSTON, 63 Oliver Street.
CHICAGO, Phenix Building.
DENVER, 1316 Eighteenth Street.
CINCINNATI, Cincinnati Electric Light Company.
ST. LOUIS, 411 N. 11th Street.
SAN FRANCISCO, 35 Market Street.
WASHINGTON, 609 Twelfth Street.



Constant Current Fan Outfit.

C. & C. ELECTRIC MOTOR COMPANY,

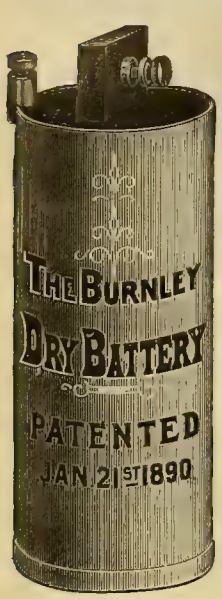
402 and 404 Greenwich Street, NEW YORK.

DETROIT ELECTRICAL WORKS,

DETROIT, MICH.,

Manufacturers of the Celebrated

UNIVERSAL FARADIC MEDICAL BATTERY,



using dry Burnley cell, thereby dispensing with the inconvenience and annoyance of fluids. Cases and all parts handsomely made and finished.

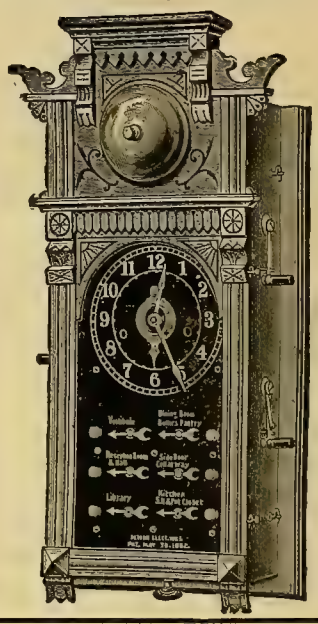
ANNUNCIATORS

for Hotels, Residences and Railroad Cars, in various styles and sizes.

These Annunciators are very simple and perfect in construction, have long life without repairs, and are in general use throughout the country.

Also manufacturers of Telephone, Telegraph and general Electrical Supplies and Merchandise, including Magnet and Annunciator Wire in all sizes and finish.

Bare Copper and Galvanized Iron Wire carried in stock. Prices quoted on application, and subject to change of market on Copper Wire.



"WARD" ARC LAMPS,

FOR CONSTANT POTENTIAL CIRCUITS.

THOUSANDS IN USE

On both Isolated and Central Station Plants.

We Guarantee our Lamps Electrically and Mechanically.

In corresponding please give full particulars and state voltage.

Electric Construction and Supply Co.,

Phenix Building, CHICAGO, ILL.

Established 1881.

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TRADE MARK.

823 Locust St.,
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NICKEL-PLATED

Speaking Tube Whistles.

WITH OR WITHOUT INDICATORS.

Our Kansas City Branch:
Gate City Electric Company,

OKONITE
TRADE MARK.

522 Delaware St.,
KANSAS CITY, MO.

WE HAVE A

LARGE STOCK

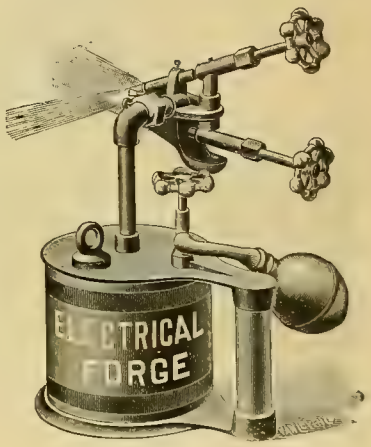
of these **SPEAKING TUBE WHISTLES** on hand, which we will dispose of at the following prices:

1 dozen lots,	-	-	$2.00.
5 " "	-	-	1.75.
10 " "	-	-	1.50.
25 " "	-	-	1.40.
50 " "	-	-	1.35.
100 " "	-	-	1.30.

Electrician's Torch.

The ELECTRICIAN'S TORCH

Is safe, durable, easily repaired, has a reversible burner that can be used in any position and will not blow out in a gale of wind. Can be used as a Blow-pipe Torch or a Fan-tail Heater and can be instantly changed from an intense heat to a feeble flame, or the reverse.



No. 1. Helper Forge.

The No. 1 HELPER FORGE

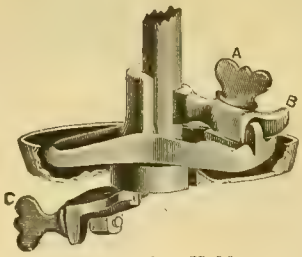
Can also be used in the highest wind. One gallon of 74° deodorized gasoline will run it all day. It is made to stand hard work.

Upper Carbon Holder.

These

CARBON HOLDERS

Are designed especially for Thomson-Houston and Brush lamps, and are sold at very low prices. We also have a lot of Thomson-Houston lower carbon holder rings.



Lower Carbon Holder.

We are now exclusive Western Agents for

Commercial Fire-Proof Lamp Cord, Packard Incandescent Lamps, Bryant Sockets (all Porcelain and Brass), Okonite Wire, Improved Candee Wire.

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Connected by Private Wire with Postal Telegraph-Cable Company's System.

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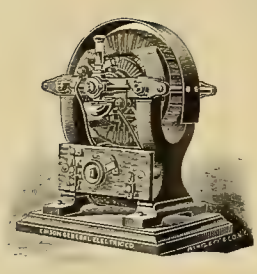
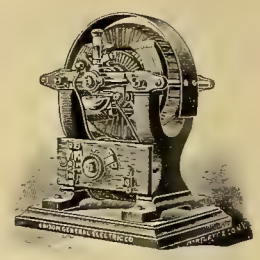
DENVER, COLO.

EDISON GENERAL ELECTRIC CO.,

Edison Building, Broad St., New York City.



NEW



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MINIMUM OF ATTENTION AND REPAIR.

Highest Efficiency,
Slow Speed,
No Sparking.

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1-12	$ 40	$22.00
1-6	60	33.00
1-3	100	55.00
1-2	125	78.75

Independent Coils,
Improved Lubrication,
Mechanically Perfect.

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VOLTMETERS. TRADE A.B.C. MARK **AMMETERS.**

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ARC AND INCANDESCENT LAMPS.

THE ELEKTRON MFG. CO.,

79 and 81 Washington Street, Brooklyn, N. Y.

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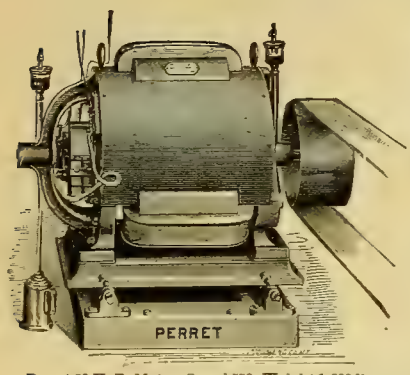

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Perret Electric Motors and Dynamos

LAMINATED FIELD MAGNETS, HIGH EFFICIENCY, LOW SPEED, FULL POWER.

Motors of any size for any purpose. Factories equipped throughout with Electric Power Isolated Plants for Incandescent Electric Lighting.

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Manufactured under Authority of SIEMENS & HALSKE,

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Pacific Northwest District: Fleischner Building, Portland, Ore.
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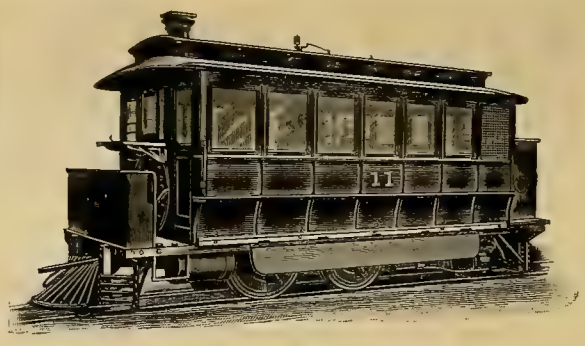
Southern District: 10 Pecatur St., Atlanta, Ga.

STREET CARS



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ON ACCOUNT OF

Increase of Business

AND THE

Adoption of Electricity.

THE

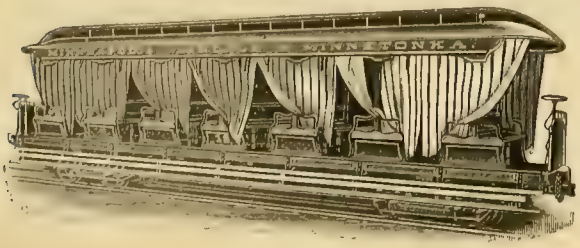
MINNEAPOLIS STREET RAILWAY CO.,

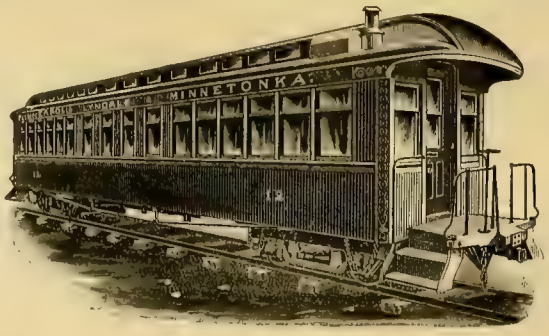
Of Minneapolis, Minn.,

OFFER FOR SALE THE FOLLOWING EQUIPMENT:

63 12-foot Cars, all fitted with Fare Boxes and "Small" Conveyors.
76 Extra "Small" Conveyors for 14 and 16 ft. Cars.
63 Extra "Slawson" Fare Boxes.
12 Steam Motors, 15to 20 Ton.
2 Locomotives and Tenders, 20 and 25 Ton.
21 Passenger Coaches, 26 to 40 ft.
34 Open Passenger Excursion Cars, 34 ft.
8 Flat Cars, 30 ft.

Most of the cars have been in service only a short time, and all are in first-class condition. We can make changes or alterations and fit them up to suit, and will sell very cheap. The gauge of any of the cars can be changed to suit purchaser. Full description and photographs mailed upon application.





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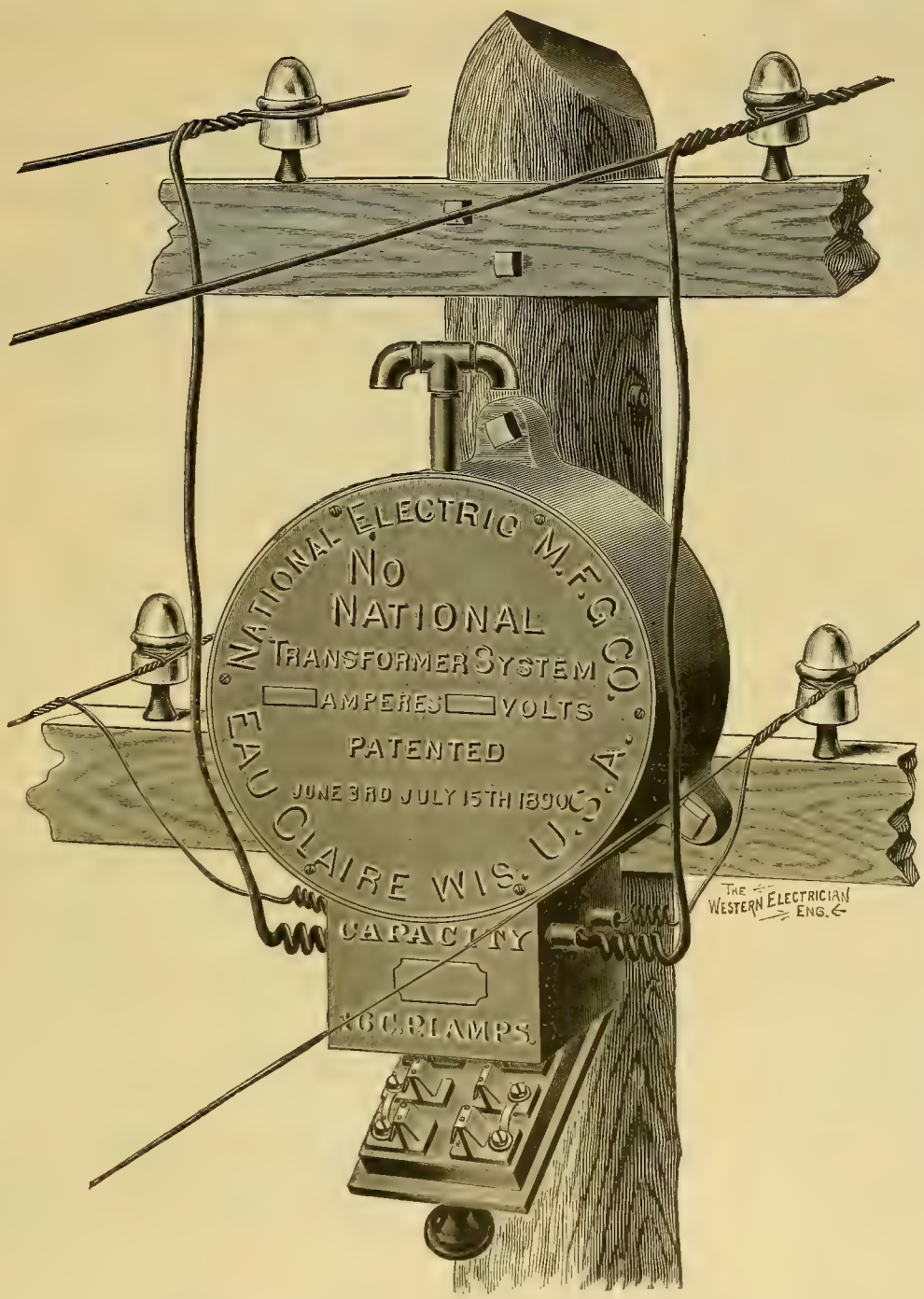
CONVERTER EFFICIENCIES.

It Will PAY YOU to throw out your present transformers and substitute OUR MAKE.

No more Accidents from Grounded Circuits.



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No more Burnt Fingers or Melted Screw Drivers.

They are the most efficient, {95.2%.} They are absolutely safe. Their regulation is practically perfect.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND
PROTECT OUR CUSTOMERS.

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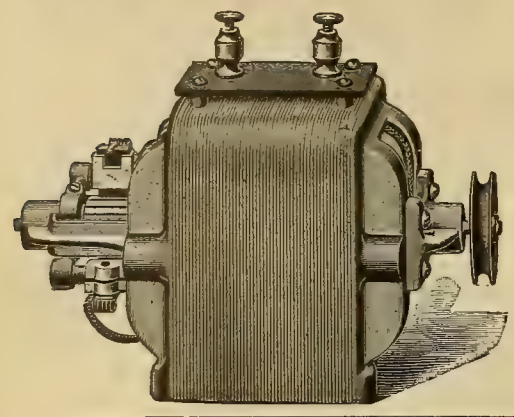

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SIMPLE. RELIABLE. DURABLE.

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Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

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HAS NO EQUAL.

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Transformers or Converters are a CONSTANT source of TROUBLE and EXPENSE, will cost MORE for repairs in a year than to renew the Lamps by our system.
Our PLANTS can be operated with success ELECTRICALLY and FINANCIALLY where no others can.
Plan of wiring SIMPLE, CHEAP and EFFICIENT.
LAMPS from 16 C. P. up, noted for BRILLIANCY and BEAUTY of the light.
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COMPOUND-WOUND. SELF-EXCITING.

Perfect Self-Regulation.

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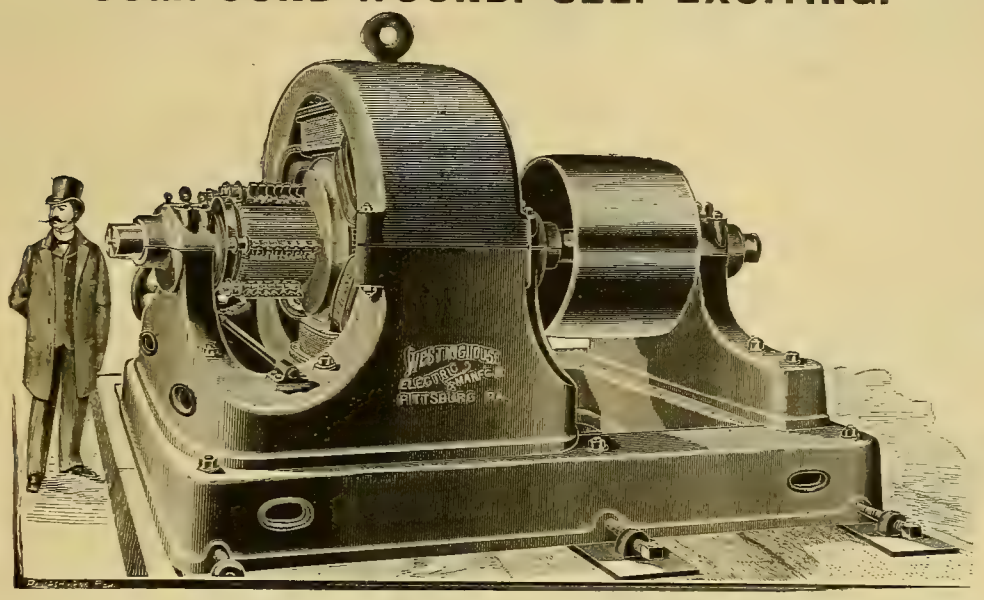

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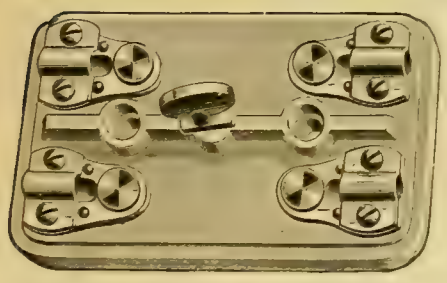

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Single Light, Main and Branch,

OF SUPERIOR PORCELAIN,

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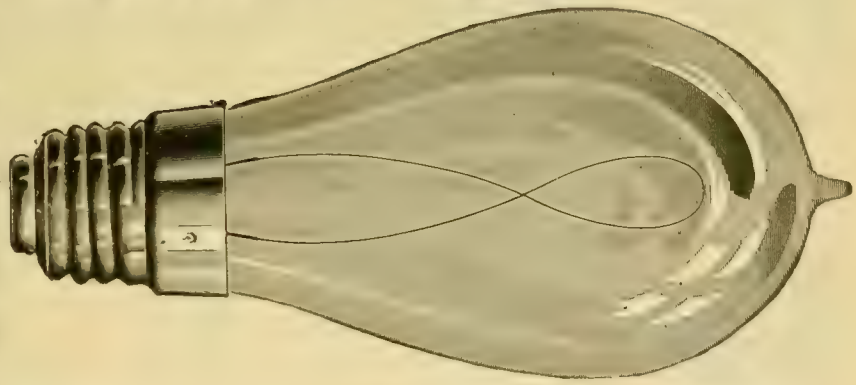
LAMPS OF ANY C. P. VOLTAGE BASE.



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CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

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Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

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FOR MECHANICAL PURPOSES,

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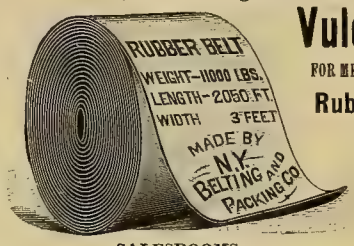

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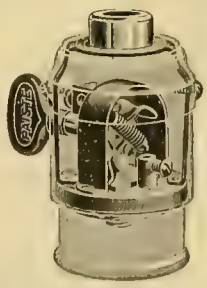

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EVERY SATURDAY.

Vol. VIII. CHICAGO, JUNE 27, 1891. No 26

Electricity in Spectroscopic Astronomical Work.

Kenwood Observatory was dedicated last week, and now Chicago has another institution of which it may well be proud. This station, as it stands, was the gift of W. E. Hale of the Hale Elevator company to his son George E. Hale.

For several years young Mr. Hale has been an enthusiastic amateur astronomer, and the bulk of his work, outside of that done at college, was carried on in a small brick building on the corner of Drexel boulevard and Forty-sixth street. The present observatory is a most thoroughly equipped enlargement of the old plant. Graduated recently from the Massachusetts Institute of Technology and having decided to make a life study of spectroscopic analysis as applied in astronomical work, the station, now under Mr. Hale's exclusive control, will facilitate the pursuit of investigations which have already secured him a name and brought him in contact with the foremost astronomers of the country.

Imbued with the desire personally to inspect an observatory so thoroughly fitted out, and at the same time, to procure data through which the readers of the WESTERN ELECTRICIAN might be informed as to the extent to which electricity enters into this particular line of astronomical investigation, a representative of this journal called upon Mr. Hale, and through his courtesy obtained the accompanying views.

The visitor entering the building on Forty-sixth street, Fig. 1, first finds himself in a handsomely furnished reception room or office proper. Adjoining this reception room and to the left, is the lower room of the dome tower, which is of two stories. This circular apartment is used as a study and library. Just above it and mounted upon a substantial pier extending up through the library from solid foundations in the basement is the telescope carrying the spectroscope, Fig. 2. The rotary dome covering this instrument is twenty-six and one-half feet in diameter and permits of a focus of eighteen feet. The telescope is a twelve-inch refracting equatorial. It was built especially to carry the spectroscope. The total length of the instrument is twenty-two and a half feet. The telescope was built by Warner & Swasey of Cleveland, O., and the spectroscope was manufactured by J. A. Brashear of Allegheny City, Pa.

Adjoining and in the rear of the tower, so as to be conveniently reached from the dome or observatory proper, are the photographic dark room, the "grating room," the "slit room" and the general laboratory. There is also another room in a building away from the observatory, containing electric lighting apparatus.

An idea of the appearance of these several apartments, with the exception of the "grating room," of which no photograph could be obtained, may be had from the several views. From the glimpses given, the reader familiar with electrical apparatus will have no difficulty in appreciating the fact that the astronomer carrying on spectroscopic investigations finds electricity to be a most useful and valuable agent. One would hardly expect to see in service in such a laboratory a line of instruments which would make up a goodly proportion at least of the necessary equipment of the test room of the electrical engineer. The part played by electricity in the Kenwood observatory will be better understood, perhaps, after a few words of explanation relative to the particular work which is now in progress.

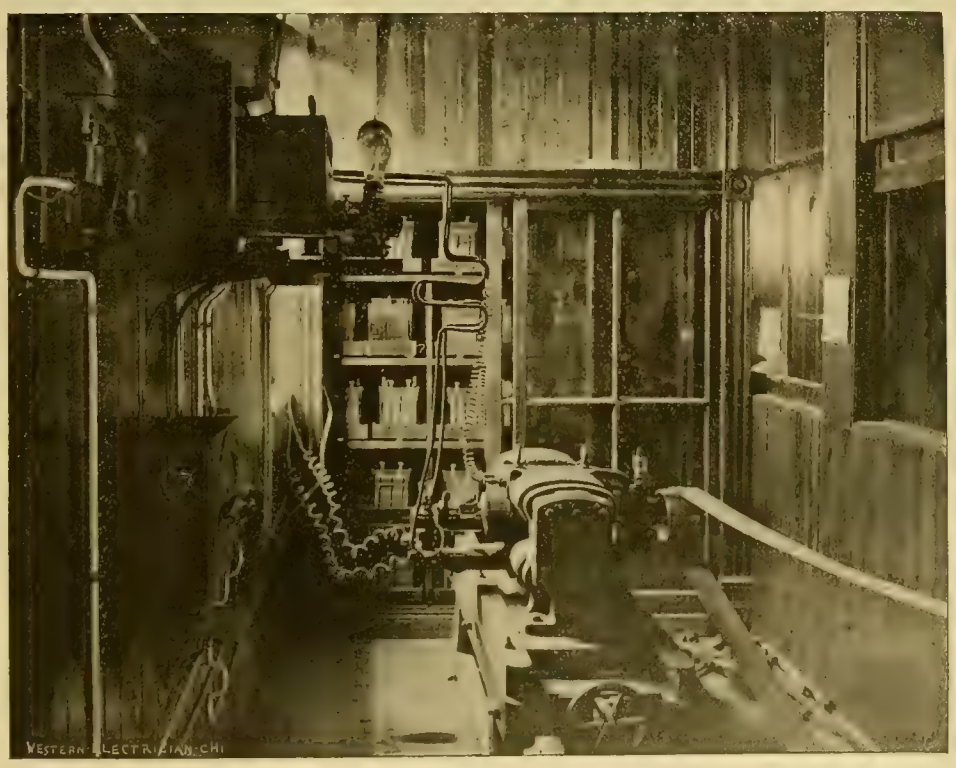


FIG. 5. ELECTRICITY IN SPECTROSCOPIC ASTRONOMICAL WORK.—GENERATING PLANT.

At the present time there is being prosecuted by the aid of photography, an original investigation of the invisible solar prominences. As few persons are familiar with the application of the spectroscope to this work, it may be stated that the electric arc is used to burn refractory substances whose spectra are desired for comparison with such other spectra as may be obtained from the solar prominences. The manner in which the lines of the two spectra are recorded so as to facilitate an accurate and ready comparison, is indicated in Fig. 3. The methods employed to secure such photographic records will be the more clearly understood from an account of a few of the details of the process through which the spectrum of iron at the temperature of the electric spark, is compared by means of the concave grating spectroscope, with the spectrum of the sun.

First, to obtain the negative of the sun's spectrum, a beam of light is reflected through the laboratory, Fig. 7, into the "slit room," Fig. 4, from a heliostrat placed in the yard of the observatory.

Inside the slit room the beam is passed through a quartz lens of 35-inch focus and thence through the spectroscopic slit on to the grating in another apartment, suitable absorbing solutions being interposed before the slit to cut out the overlapping spectra.

Falling upon the grating the beam of light is broken into a series of spectra, and a portion of one of these spectra is made to fall upon an exposed half of a sensitized plate bent to a curve of 5 feet radius. As soon as the solar spectrum has made its impression upon its half of the plate, the beam of sunlight is cut off. The next step in the process brings the electrical apparatus into play. As the spectrum of iron is the one which is to be impressed alongside that of the sunbeam, two blunt electrodes of the pure metal are made ready in front of the quartz lens in the slit room. To the iron electrodes, which are placed about ¼ inch apart, are attached the secondary terminals of the large induction coil, shown upright in the picture, and the several Leyden jars connected in parallel across the secondary terminals, serve to increase the quantity of the discharge.

After the electrodes are thus arranged in the slit room and all light excluded, the remaining portion of the sensitized plate, which up to this time has been kept covered in the grating room, is exposed, while the half containing the impression of the sun's spectra is screened. The next step consists merely in causing the electrical discharge and thus obtaining a representation of a second spectrum (that of the iron) upon the same plate with the sun's spectrum.

It will not be amiss to mention that the slit ordinarily used is $\frac{1}{1000}$ inch in width and the spectroscope grating, which was ruled by Prof. Rowland of the Johns Hopkins University, contains 14,438 lines to the inch, and its face measures 3⅝ inches long by 1⅜ inches wide. Its radius of curvature is about 10 feet.

In certain cases the analysis is carried on by the aid of the arc lamp. The two processes are very similar. For instance, the upper spectrum of the two shown in Fig. 3, which will enable the reader to compare the spectrum of Vesuvius lava with the solar spectrum, was obtained by burning a bit of lava in the crater of the arc lamp pencil, shown prominently in the view of the slit room.

The type of carbons used in this lamp is the Carre, imported from Paris. These pencils are reputed to be pure, but the spectroscope tells a different story. It may be stated that the Kenwood observers have never been able to obtain carbons which they considered to be entirely satisfactory for spectroscopic purposes-

The current for the arc lamp is supplied from a compact little plant located in another building just in the rear of the laboratory. The arrangement of this installation, which was at one time employed to light Mr. Hale's residence, is shown in Fig. 5. Fig. 6 is a cut of the 6 horse power gas engine which drives the 70 volt Weston dynamo. There is also a set of 35 Julien storage cells which may be brought into service when desired. One of the features of the gas engine is an electrical mechanism for igniting the explosive mixture in the cylinder. The small dynamo shown in the cut is the essential portion of this equipment.

At the present time and since the alternating lighting system of the Hyde Park Electric Light

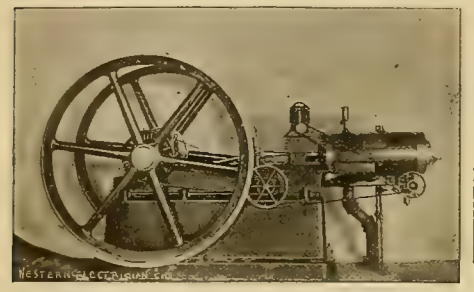


FIG. 6. ELECTRICITY IN SPECTROSCOPIC ASTRONOMICAL WORK.—GAS ENGINE IN GENERATING PLANT.

company was put into operation in Kenwood, the current at 52 volts from the secondary of a 20 light transformer is employed, through the aid of resistances, in the primary of the large induction coil in the the slit room. The central station current is used when work is in progress during the evening. At other times the direct current is applied to the coils, and a mercurial circuit breaker driven by the small motor shown behind the arc lamp in the cut of the slit room, is brought into service.

When it is desired to secure photographic enlargements of spectra, the negatives are made in the slit room by the aid of camera lenses. It must not be forgotten, too, that there is in the slit room a Geissler pump for exhausting various forms of vacuum tubes used in studying the nature of gaseous spectra.

Taken all in all, electricity does its share of the work in the Kenwood observatory. As one on passing out gives a last look at the big telespectroscope, and is told that just behind the little glass door in the mounting there is a simple electric stop mechanism, operated by an astromonical clock in the basement, through which the movement of the huge instrument is checked and governed with almost absolute accuracy—not to mention the tiny one-candle power incandescent lamps for illuminating the scales on the circles—there arises involuntarily the feeling that, as yet, few have a proper appreciation of the extent to which electrical methods are being employed by those not denominated as, or claiming to be, disciples of Faraday.

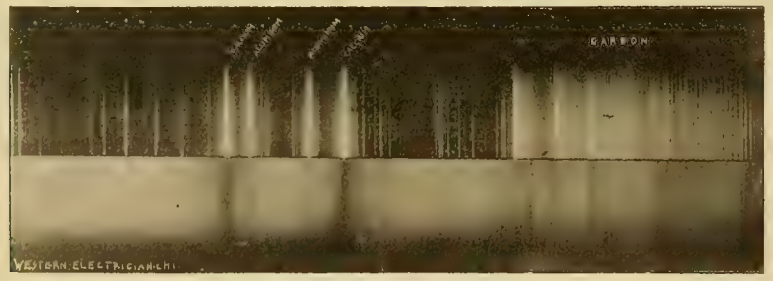


FIG. 3. ELECTRICITY IN SPECTROSCOPIC ASTRONOMICAL WORK —SPECTRUM OF VESUVIUS LAVA COMPARED WITH THE SPECTRUM OF THE SUN.

Writing Telegraph Tested.

Before a number of newspaper men the writing telegraph system was tested in Chicago on June 21st. The terminals of the line were at the New York and Chicago offices of the Postal Telegraph company, making this by far the longest test to which the new invention has been subjected. The distance covered was said to be 1,030 miles, and ordinary telegraph wires were used. An hour and a half was consumed in making the test, and the results were, on the whole, very satisfactory. The newspaper men did not have sufficient dexterity with the stylus to write legibly, but W. E. Gump, who conducted the test at the Chicago end for the Writing Telegraph company, sent a number of messages successfully. The following, which was satisfactorily transmitted, was sent to James Gordon Bennett, *New York Herald:*

CHICAGO, June 21.—The ability of the writing telegraph to transmit legible autographic messages 1,000 miles was put to a test to-day, New York and Chicago being the contesting points. Allowing for interference, the test was successful. The writing at this end was done by General Manager W. E. Gump.

Mr. Gump expressed himself as gratified with the result of the long distance test. What trouble there was, he explained, was mainly due to the fact that the wires used for the writing telegraph in New York frequently came in contact with the wires used for the Morse instruments. In the construction of commercial lines such trouble, he said, could be easily avoided, while all difficulties caused by atmospheric influences could be readily overcome.

Electrical Department, World's Fair.

On Wednesday of last week Chief Barrett returned from his Michigan trip, feeling much better. But little has been done in this department, however, since last week. A meeting of the committee on electricity was to have been held last Saturday, but there was no quorum. Matters are in a quiescent state pending a definite decision regarding the arrangement for power.

Last Tuesday the committee on electricity met at the headquarters of the department. The chief was authorized to appoint an electrical engineer as his assisstant, and he immediately named E. E. Keller. The appointment was promptly confirmed. Mr. Keller is 28 years of age, and a native of New York City. His boyhood and youth, however, were spent in Rochester, N. Y., where his father, a well known florist, still resides. He was educated in the public schools and University of Rochester and afterward entered the establishment of Yawman & Erbe, optical instrument makers. After this he began to make electricity a special study and accepted a position with G. H. Blaxter & Co. of Pittsburg. This firm was merged into the Keystone Construction company, and in 1888 Mr. Keller opened the Chicago office of this company, remaining in charge when the Keystone consolidated with the North American Construction company. A short time ago he accepted the position of electrical engineer at the Chicago office of the Fort Wayne company. He will immediately enter upon his new duties, with headquarters at the office of the electrical department.

The last number of *Whipple's Reports* says:

With an united industry urging common sense and reasonable demands upon the directors, Chief Burnham has seemingly convinced them that the electrical interests do not know what they want, while he has great chunks of gray brain matter to spare. Any one with cuticle thinner than cowhide would, long ago, have learned that the interests of a successful exposition are being prejudiced by a refusal to give more space and better power facilities to this important division, but Chief Burnham sets himself up on a personal pronoun and, metaphorically, stuffs his ears with indifference. Mr. Edison told him, the other day, that the electrical building was evidently designed by an artist rather than by an electrician, but this mild sarcasm was entirely lost on the chief of construction, who accepted it as a compliment.

It really seems too bad that the electrical interests are obliged to contend for that which is theirs by right of reason, and which they should have without question. It will not interfere with the ambitions of any other industry to grant what is necessary in this case, and the directors have shown a narrow gauge disposition that is out of place, and wholly unlike the spirit that is commonly supposed to actuate Chicago enterprise. If the electrical features are worth having at all they are worth all they demand, especially when this demand is based on wisdom, experience and judgment. The gentlemen of the board who know anything about the subject they are required to legislate upon, are earnest advocates of more extented facilities, and their associates ought to profit by this knowledge and act accordingly. Otherwise there will be a shifting of responsibility pretty soon that will be likely to make some folks exceedingly fatigued.

German manufacturers are thinking seriously of disregarding the World's Fair in '93 if the press dispatches may be relied upon. They argue that the protective tariff makes it impossible for them to compete with American manufacturers in this country, and that it would, therefore, be folly to undertake the expense of

FIG. 1. ELECTRICITY IN SPECTROSCOPIC ASTRONOMICAL WORK.—THE OBSERVATORY.

exhibiting their articles of manufacture at an American exhibition. A Berlin correspondent sends an interesting report of a conversation with Dr. Werner Von Siemens, who is a leading member of the committee having in charge the preparation for the great German fair of 1896, which it is hoped will occupy Europeans and keep them from displaying at Chicago:

"We will have no humbug, no Eiffel tower or similar attraction," said the German electrician, "but we will make a solid showing of what we can do in the way of manufacturing. It will be a business affair throughout. We may meet with some opposition on the part of France, but, aside from her, we shall be sustained by all Europe. The European nations are becoming aware that they must consolidate commercially as against American aggression. America is not only shutting out many of our products by prohibitive tariffs, but she also threatens our trade with the South American republics, and even with Africa and Asia. Your country is

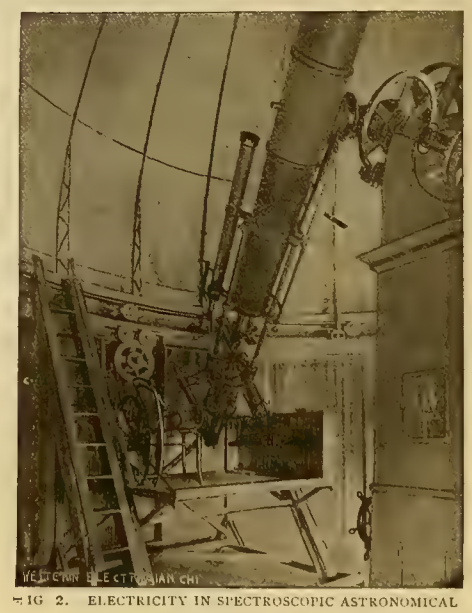


FIG 2. ELECTRICITY IN SPECTROSCOPIC ASTRONOMICAL WORK.—THE TELESPECTROSCOPE.

young, full of natural resources, and by your enterprise, no less than by your present policy, you threaten to deprive us of our foreign trade. Power naturally makes you aggressive, and Europe must take care of her interests or else she will be pushed to the wall."

"Will you exhibit at the Chicago Fair?"

"I do not know as yet. At present it seems to me folly to exhibit in a country where people will not buy from us."

Municipal Lighting.

With the development of the municipal lighting system in Chicago the importance of that department in a political sense is being recognized and already there are signs of attempts on the part of political leaders to secure control of the administration. As has already been stated in these columns, Prof. Barrett has studiously kept the department free from political interference, but it is only a question of time when the pressure will be too great to resist. The first public attempt to gain a footing was made in the city council last week when an effort was made to secure the appointment of an inspector of underground electric systems. The occasion was afforded by the discussion of the question of man-hole explosions. A report on this subject was under discussion. The city electrician said the explosions were occasioned by illuminating gas escaping from leaky mains permeating the conduit system. The gas had been ignited by matches or candles used by men working in and around the man-holes and conduits. There may have been a few instances, it was stated, where the ignition was due to an electric spark.

"The most effective remedy," the report continues, "for avoiding these explosions is to confine the gas to the gas mains, and some effort should be made in this direction. Until this is done ventilation of the conduit systems must be resorted to. The latter has been experimentally applied in several forms by the City Telegraph Department."

The recommendation for the appointment of an "inspector" is not received with favor even by the Republican press. The Chicago *Tribune* takes occasion to express its dissatisfaction as follows:

The council has been asked to authorize the appointment of a new officer to be known as "inspector of underground electric systems." No doubt the work which it is proposed he shall do ought to be done, but why create a special office for the purpose of having it done? Why will not it be just as well for the commissioner of public works and the city electrician to detail an employe to attend to the matter? The work will be done just as thoroughly, probably more so. For if this new office is created the man who fills it will want a salary to fit the long title. Then he will ask for an assistant, and then for a clerk Then he will want his office turned into a 'bureau," with more assistants and clerks. He will recommend that the city be divided into four or five districts, each of which will need an inspector. The first thing that any one knows this one small office will blossom out into a "department" with a commissioner at the head of it.

So the council should be in no haste to create this office. There are already a large number of "inspectors" around the city hall who do only a small amount of inspecting, probably because much of their time is taken up in supporting the dignity of their titles. The work of looking after underground electric systems will be done quite as effectively by a plain man detailed for that purpose who does not feel the necessity of putting on any high style and employing an office full of tax-eaters to do his work by sogering about it.

Electrical Exports.

The steady and rapid increase in the exports of American electrical apparatus is gratifying to every member of the electrical fraternity. "The amount of electrical material shipped from the port of New York since the 1st of April, as noted by the custom house returns," says the *American Exporter* for June, "comprises a total of 2,783 cases valued at $64,292. These goods were shipped to Brazil, British West Indies, Cuba, Central America, Mexico, Argentine Republic, United States of Colombia and Venezuela, and consisted of electric light apparatus, telephone and telegraph materials. This is one third more than in the corresponding period last year. Quite a number of street electric railway contracts have lately been closed for South American cities, and material for these roads is now in course of shipment. The outlook of the electrical supply trade business is particularly bright, and our manufacturers would do well to cultivate this trade. The number of central stations in active operation in the towns of Latin America exceeds one hundred and twenty, and they vary in capacity from 30,000 to 2,000 lamps. There being no electrical factories in these countries, every article has to be imported, either from this country, England, France or Germany. By rights the bulk of this trade should belong to this country, and with increased shipping facilities no doubt this will shortly be the case."

FIG. 7. ELECTRICITY IN SPECTROSCOPIC ASTRONOMICAL WORK.—LABORATORY OPENING INTO SLIT ROOM.

Electric Railways in Chicago.

A new electric road has been projected for the North Side, Chicago. The proposed route is from Diversey avenue on Evanston avenue to the Ridge road, along the Ridge road to Oakton avenue. At this point a T will be formed by one line running east to Calvary cemetery and another west connecting the main line with the Montrose cut-off. The road will open up for settlement an entirely new section of country and be of great benefit to South Evanston. It is intended to build the road this summer. The work will be done by Loss & Son, who at present are building an electric road at Kankakee. The trolley wires will be strung by A. D. Hatch.

Contracts have been let for the construction of extensions to the lines of the Cicero & Proviso street railway on Madison street from Harlem avenue, the present terminus, to the Desplaines river, and on Desplaines avenue, from Madison street south to Twelfth street. The road is to be double tracked The electrical equipment will be put in by the Edison General Electric company. The rolling stock for the road is now being built at Pullman and will consist of twelve motor cars with two twenty-five horse power equipments to each car, geared to run from twenty to twenty-five miles per hour. These cars will draw open trail cars, of which a large number have already been ordered from the St. Charles Car company of St Charles, Mo. A new engine is now being put in the power house at Ridgeland and additional generators are being put in place. The new lines will be completed and in operation by Aug. 1st. The present road is succeeding far beyond the expectations of its projectors and has had a wonderful effect upon the value of property along its lines.

Rewards of Electrical Inventors.

A New York correspondent of the *St. Louis Globe-Democrat* says: "No scientific body in the country has so many millionaires as the American Institute of Electrical Engineers. At the top of the list is Alexander Graham Bell, whose profits on the telephone are represented by eight figures. Next comes Edison with a seven-figure fortune. Brush, of electric light fame, and Elihu Thomson, whose financial future is perhaps brighter than any of the others just now, are more than millionaires. Frank J. Sprague was a junior officer in the United States navy six years ago. He is now living in the mansion which was built for the Grants. His company sold out to the Edison company for $1,000,000, and half of it went to the inventor. Wm. Stanley, Jr., sold his patents to the Westinghouse company for $150,000. Edward Weston, who introduced the Weston plating-machine, made himself rich and did more for art than any one else of this generation. J. P. Caton, of Ottawa, Ill., is credited with having cleared $250,000 out of lighting patents. George W. Stackley of Cleveland got $500,000 and Chas. S. Haskins of Milwaukee pocketed a like amount for improvements in lighting machinery. Franklin L. Pope of New York and a score of others have independent fortunes. Some of these men were telegraph operators, and most of them began their experimenting and study without a dollar."

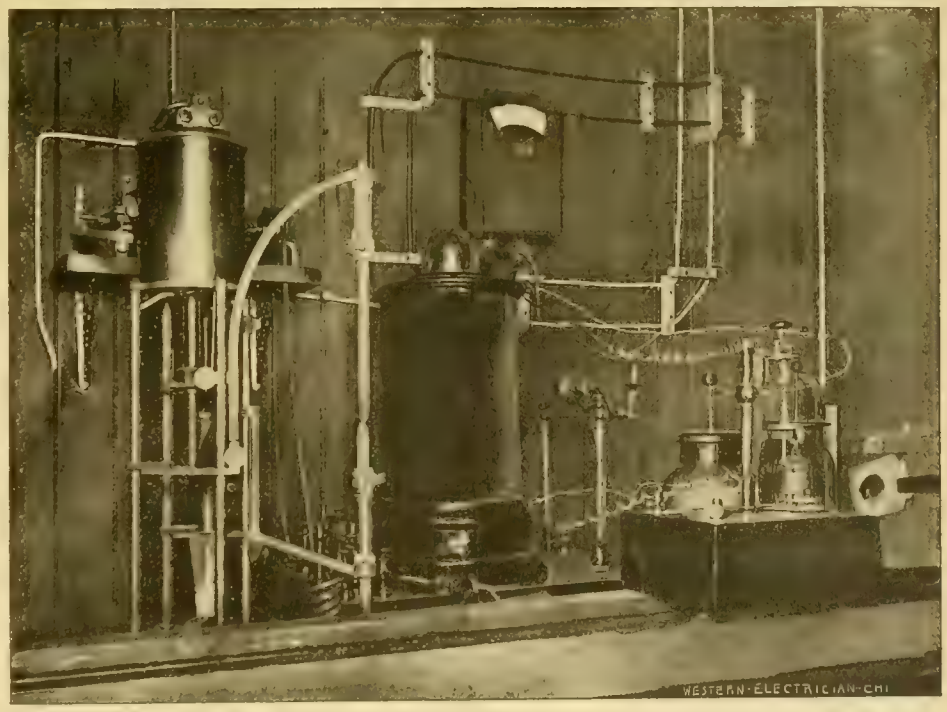


FIG. 4. ELECTRICITY IN SPECTROSCOPIC ASTRONOMICAL WORK.—THE SLIT ROOM.

Simple Controller for Incandescent Lamps.

Incandescent electric lamps are especially useful in connection with scenic exhibitions on account of the softness of the light and the fact that the lamps may be controlled as to number and brilliancy with the greatest facility. They

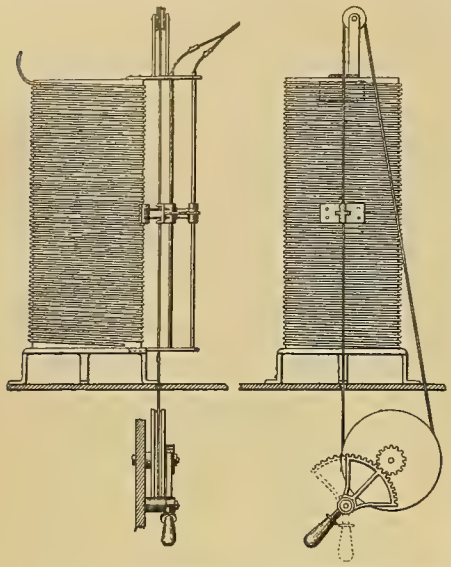


FIG. 1. SIMPLE CONTROLLER FOR INCANDESCENT LAMPS.

are of special advantage in giving the effects of sunrise and sunset. A requirement of the apparatus for these effects is that its action should be so uniform and gradual that there will be no abrupt changes in the light, so that the effect may be that of a gradual change from light to darkness, or vice versa. This gradual variation in the light must be, as to speed, under the control of the manager.

Accordingly, to accomplish these results, J. J. Fanning, Chicago, has devised the simple form of rheostat shown in the cut. The rheostat consists of wire wound about a cylinder, as indicated. The wire should be of less size in cross-section as it approaches the lower portion of the cylinder. Mr. Fanning states that a coil of ordinary galvanized wire consisting of two hundred and twenty-nine feet of No. 7 wire, two hundred and twenty feet of No. 10 wire, and one hundred and ninety-four feet of No. 12 wire has been found sufficient to control a group of sixty-one 16 candle lamps, operating at a pressure of 115 volts. In this case each lamp takes about half an ampere, and the current in the coil at the commencement would therefore be thirty and one-half amperes. The whole coil, when inserted, would reduce the current about one-half—that is, to about one-fourth of an ampere for each lamp. When thus reduced the lamp is practically put out, its filament appearing red, and giving out not to exceed one candle power of illumination. The brush or rubber, Fig. 2, is made of copper ribbon folded together and kept pressed constantly against the wire on the cylinder.

Montreal Convention.

Manufacturers and dealers in electrical supplies throughout the country have received

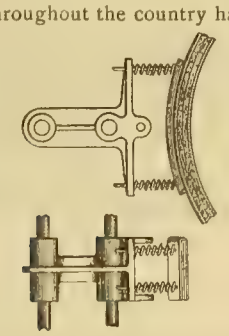
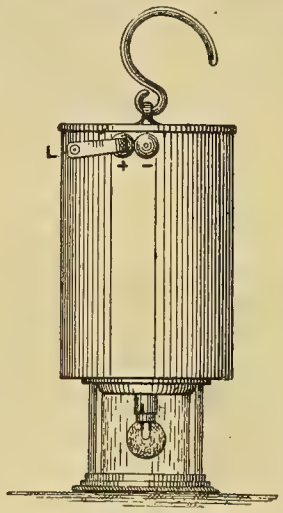


FIG. 2. SIMPLE CONTROLLER FOR INCANDESCENT LAMPS.

the first circular letter from the committee on exhibits of the National Electric Light association, relative to the coming convention at Montreal in September. The exhibition will be open from September 7th to 16th, inclusive, in the Victoria skating rink, which has a floor space 228 by 110 feet. To prospective exhibitors Chairman Gulick says: "We think you will find it to your interests to lend your most hearty co-operation, and we would be pleased to have you join in this exhibit and place before the many delegates at the convention, as well as the public, some attractive and novel feature of your business. The committee on exhibits expects to arrange that all goods for the exhibition shall be admitted into Canada in bond, free of duty; duty payable only if sold." Applications should be forwarded to James I. Gulick, 136 Liberty street, New York.

Electric Safety Lamp for Miners.

In the accompanying illustration is shown a new English electric miners' safety lamp, invented by G. E. Smith of Nottingham. A secondary battery is used, and each of the cells composing the battery is separate and independent. Should any accident require one or more of the cells to be replaced, it can be done in a few minutes at the colliery, spare cells being kept in stock. If any irregularity is observed in the lamps, each cell can be tested in a few minutes with the voltmeter, and the bad cell taken out, a new one put in, and the lamp sent into the pit as usual. The cells are made with a special plate which is claimed to give greater electric capacity for a given weight than any other. The battery is contained in a circular metal case. The lamp is made in two sizes, the smaller of which weighs about 3¾ pounds and is reported to burn seven or eight hours. The larger lamp, which is claimed to burn ten hours, is double the size of the smaller one; it contains double the number of cells, and gives



ELECTRIC SAFETY LAMP FOR MINERS.

double the light, and is of course, heavier in weight. It takes about four to five hours to recharge the smaller one, and about six or eight hours to charge the larger one; it is possible to do this in a shorter time, but a slower charging is preferred.

Order of Railway Telegraphers.

At St. Louis last week the sixth annual convention of the Order of Railway Telegraphers of North America was held About 200 delegates were present, representing the 16,000 members of the order.

Considerable time was taken up by a discussion of the advisability of eliminating the anti-strike cause in the constitution. There was also a strong faction in the convention that favored amalgamation with the Brotherhood of Telegraphers. Committees from the two organizations met in conference, but were unable to agree on a basis of union. It is reported, however, that an amicable agreement was reached whereby the two orders will proceed to organize the telegraphers of the United States, one not encroaching on the other's territory—that is, the brotherhood will take in commercial operators and railroad telegraphers not members of the Order of Railway Telegraphers, while the Order of Railway Telegrapers will receive only railroad operators.

The following named officers were elected for the ensuing year: A. D. Thurston, Vinton, Iowa, grand chief telegrapher; S. O. Fox, Vinton, Iowa, grand secretary and treasurer; Hon. G. D. Ramsey, East St. Louis, assistant grand chief telegrapher; J. A. Lecanda, Celaya, Mexico, grand senior telegrapher.

During the first week the Frankfort electrical exhibition was open, 29,773 persons visited it.

Fire-Proof Resistance Box.

The resistance box shown in the cut was designed by Rudolph Eickemeyer, Jr., of Yonkers, N.Y., with the object of securing immunity from fire in electric elevator service.

This box consists of a series of cast iron frames formed as shown in Fig. 1, and provided at each corner with a tubular ear, by means of which a number of the frames may be united, as indicated in Fig. 2, so as to form a pile which can be inclosed by a rectangular case. An inspection of Figs. 2 and 3 will show the manner in which the coils are strung on the frames and

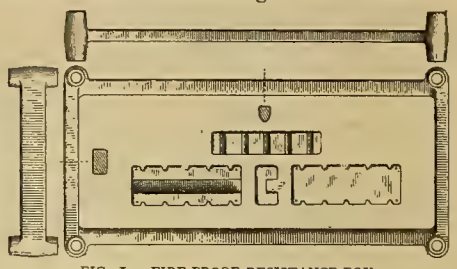


FIG. 1. FIRE-PROOF RESISTANCE BOX.

insulated by grooved porcelain bars. The details of construction of the various parts are presented more clearly in Fig. 1, which represents both the iron frame and the porcelain insulating pieces.

Large Accumulator Plant at St. Paul.

James J. Hill, the railroad magnate, is building a costly residence on Summit avenue, St. Paul. It will be lighted by electricity, of course, and Mr. Hill has decided to install an immense storage battery plant for the purpose. Last Monday morning he arrived in Chicago, and after a brief conference with William Hood of the Accumulator company, he placed an order for 600 storage batteries, 15 L accumulator type. The plant will be installed immediately. The Accumulator company of New York is now getting out the order. It will require two freight cars to convey the batteries to St. Paul.

Mr. Hood is naturally much elated over his success in securing the order, which is said to be the largest contract

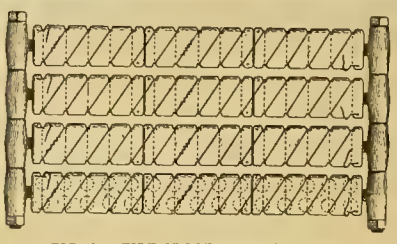


FIG. 2. FIRE PROOF RESISTANCE BOX.

for accumulators ever given. The largest storage battery plant in this vicinity at present is that installed by the Accumulator company under the direction of Mr. Hood for Potter Palmer, Chicago.

Collecting Official Statistics.

A Washington dispatch announces that a company is collecting statistics of accidental deaths in the principal cities of the country. The idea is to show the proportion of deaths from electric accidents. It is the intention of the electric people to extend the inquiry to a comparison of fires started by electric wires with fires originating in other ways. The accidental death statistics have been compiled for Washington. The figures tend to carry out the company's theory that the proportion of deaths from electric wire accidents is much smaller than supposed by the people. From the figures furnished for Washington, and covering five years, it appears that out of 299 fatal accidents, only one death was caused by an electric shock. The other accidental deaths were: Burns, 10; crushed by embankments, 22; drowned, 105; gunshot wounds, 11; explosions,

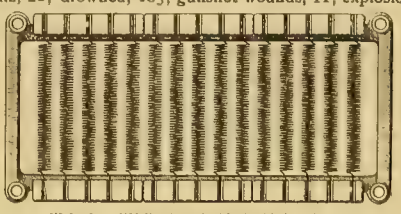


FIG 3. FIRE-PROOF RESISTANCE BOX.

2; exposure to cold, 4; falls from buildings, 30; fall of elevator, 1; fracture of skull, 26; impaled, 1; kicked by horse, 1, lightning stroke, 1; poisons, 8; run over by cars, 54; suffocation by gas, 22. Washington is one of the cities which still refuses to allow street railroads to use overhead wires except in the suburbs and less settled sections.

The Pennington air-ship is being talked about in the newspapers again. Burlington, Ia, is now said to be the headquarters of the concern, and Inventor Pennington announces that he is making a new ship that will make its "initial flight" from Burlington to New York on July 4th. This ship is to carry four passengers.

Pittsburg Municipal Electric System.

The city of Pittsburg has just completed the installation of a city telegraph system for fire alarm and police service. A complete equipment has been installed under the direction of Morris Mead, superintendent of the Bureau of Electricity. The headquarters of this department are in the Municipal building, the operating rooms occupying portions of two floors. Two views are presented in the accompanying cut, showing the handsomely carved switch-boards, which are mahogany, hand carved and in every way highly finished. In the rear of this switch-board are four pairs of panel doors hung with brass hinges on suitable separating strips and brass locks. No iron is used in its construction.

PITTSBURG MUNICIPAL ELECTRIC SYSTEM.

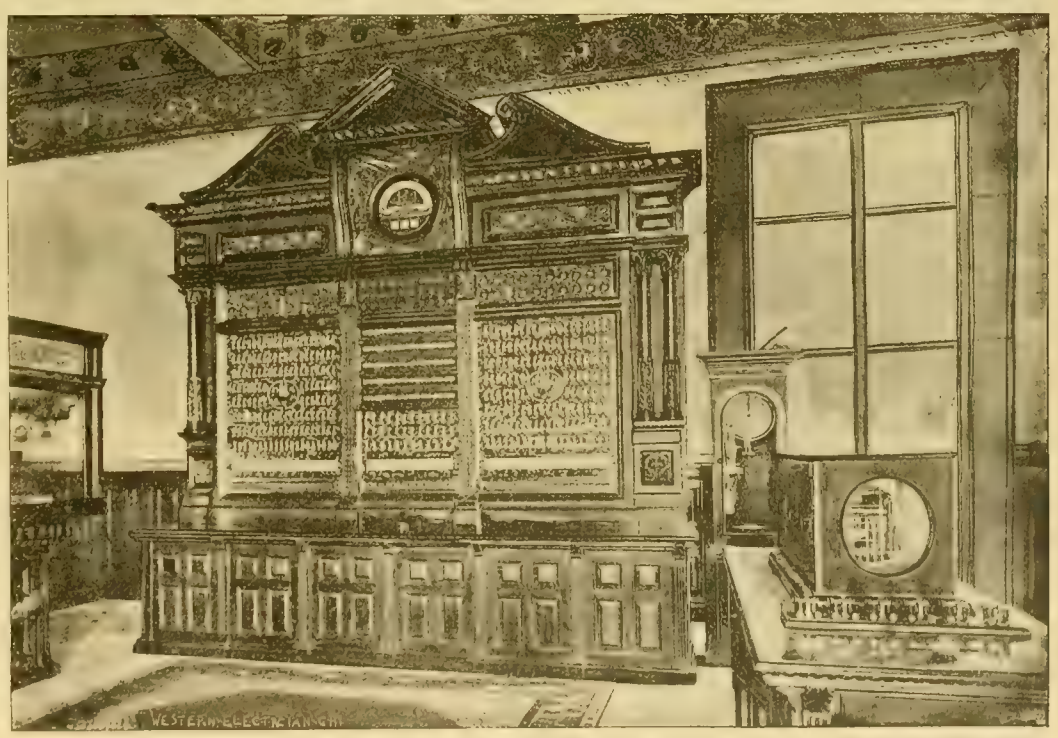
The switch straps have a Crane split German silver spring to assure easy movement and perfect contact. The upper ends of these switches move freely on brass bolts of sufficient length to go through the straps and switch-board and project sufficiently beyond its thickness to receive two sets of nuts, four copper washers and the necessary wire connection. There are on the switch-board spring jack plug switches for forty metallic circuits, consisting of eighty springs and the corresponding posts. Then there is one line of circuit terminal switches for the forty metallic circuits, and battery terminal switches in the center of each set of circuit terminal switches. Then there is also a line of heavy ground terminal switches immediately over the terminal switches already mentioned. These terminal switches are of the best brass, one-half inch thick, and varying in width according to the work they have to perform. They have 250 split plug connectors with polished hard rubber handles. There are two oval circles of circuit and battery terminal button head switches, with two center strap switches to each, and they are so arranged as to throw additional battery or reverse the battery poles on the right or left of each metallic circuit.

The equipment has forty Breguet galvanometers, which are so constructed that when the lines are in normal condition the needle shall be vertical, and any deviation from the vertical position, either to the right or left, will indicate defect or irregularity.

There is also one large galvanometer to indicate the condition of the alarm circuits. All these galvanometers are furnished with accurate index dials, on which are engraved the degrees of deflection, and they also have controlling levers placed in a recess in the center of the switch-board with heavy plate glass front in line with the face of the switch-board.

The testing arrangement of the system is composed of one rheostat and a bridge, which are used for the daily testing of the whole system.

The annunciator for the fire alarm is a very complete apparatus. It has forty numbers in a single row, and the drops are engraved to correspond with the annunciator on the switch-board. The face of the annunciator has an opening for each number, and in addition thereto an opening in which a printed list of fire alarm boxes is shown.



PITTSBURG MUNICIPAL ELECTRIC SYSTEM.

In addition to this there are forty relays with rubber magnet covers. The relays are mounted in compartments.

This system was developed and installed under the direction of Morris Mead, superintendent of the city Bureau of Electricity. Mr. Mead deserves praise for the excellent work he has accomplished.

Legal Victory for Electric Railways.

Allusion was made in this paper last week to the important decision of the Ohio Supreme Court by which the rights of electric railways in highways were adjudged to be superior to those of telephone companies. The accompanying opinion, written by Judge Dickinson, is now at hand. The language of the court in deciding the case (Cincinnati Inclined Plane Railway company *vs.* City & Suburban Telegraph association) is clear and explicit, and will be read with interest. It is as follows:

1. The dominant purpose for which streets in a municipality are dedicated and opened is to facilitate public travel and transportation, and, in that view, new and improved modes of conveyance by street railways are by law authorized to be constructed, and a franchise granted to a telephone company of constructing and operating its lines along and upon such streets is subordinate to the rights of the public in the streets for the purpose of travel and transportation.

2. The fact that a telephone company acquired and entered upon the exercise of a franchise to erect and maintain its telephone poles and wires upon the streets of a city, prior to the operation of an electric railway thereon, will not give the telephone company, in the use of the streets, a right paramount to the easement of the public to adopt and use the best and most approved mode of travel thereon; and if the operation of the street railway by electricity as the motive power tends to disturb the working of the telephone system, the remedy of the telephone company will be to readjust its methods to meet the condition created by the introduction of electromotive power upon the street railway.

3. Where a telephone company, under authority derived from the statute, places its poles and wires in the streets of a municipality, and in order to make a complete electric circuit for the transmission of telephonic messages, uses the earth, or what is known as the "ground circuit," for a return current of electricity, and where an electric street railway afterward constructed upon the same streets, is operated with the "single trolley overhead system"—socalled—of which the ground circuit is a constituent part, if the use of the ground circuit in the operation of the street railway interferes with telephone communication, the telephone company, as against the street railway, will not have a vested interest and exclusive right in and to the use of the ground circuit as a part of the telephone system.

It is announced that a syndicate of Berlin capitalists proposes to construct an electric railway from Blankenburg to Thal, and that the necessary power will be obtained from the Blankenburg central station.

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W. A. KREIDLER, - - - - - - - - - Editor and Publisher.
J. B. O'HARA, - - - - - - - - - - } Associate Editors.
F. L. PERRY, - - - - - - - - - - - } Associate Editors.
W. E. KEILY, - - - - - - - - - - } Associate Editors.
J. L. BAKER, - - - - - - - - - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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E. E. KELLER was appointed electrical engineer of the Department of Electricity of the World's Fair last Tuesday. Mr. Keller will act as assistant to Chief Barrett, and will personally superintend all engineering work in the department of electricity. Mr. Keller is a capable engineer, and his appointment will be received with favor by his associates in Chicago.

THE Order of Railway Telegraphers last week held a convention at St. Louis. One of the leading topics of discussion was the question of eliminating the anti-strike clause from the constitution. A powerful faction favored this movement, but it is hardly possible that the order will sanction such an innovation All true friends of the operators will look with disfavor upon such a proposition. The telegraphers who passed through the big strike will not forget the experience of that occasion, and they cannot look with favor on a policy that means a repetition of these trials.

THE technical journals devoted to the interests of the steam railways realize the fact that the abandonment of the steam service between St. Paul and Minneapolis on account of the competition of the electric road is significant as an indication of what the result will be of competition between cities, over lines of considerable length, where the steam railway men have heretofore had the field entirely to themselves. The *Railway Review* speaks of the problem as serious, and warns its readers that they must not be surprised if soon called upon to meet this new form of competition on the shorter lines.

CHICAGO will soon have another electric railway, and one of the electric suburban lines will be extended. This is certainly a matter of congratulation. The management of Chicago's street railway lines is not favorably disposed to the electric system. All their interests are identified with the cable systems they have adopted. The improved electric service, if substituted for the cable in Chicago, would require an immense investment, and the present cable equipment would be worthless. It is therefore not to be wondered that the companies operating the cable lines look with disfavor on the electric roads, but with the introduction of suburban electric lines these companies gained a foothold and they at once advanced in popular favor. They will continue to gain public confidence until the managers of the cable systems will be compelled to substitute electric motors. This has been done in other cities, and Chicago will no doubt secure a thorough electric system in time.

IT is announced that many foreign manufacturers are disposed to disregard the World's Columbian Exposition, owing to the fact that the protective tariff policy of this country practically prohibits them from competing with American manufacturers. It is to be regretted if such a policy is adopted, yet according to an interview cabled to this country, Dr. Werner Von Siemens said that there is a movement on foot to hold a fair in Germany, which would give the European manufacturers an opportunity they would not get here. Should this view be generally accepted it will no doubt form a great drawback to the promoters of the Exposition. For instance, American manufacturers of electrical apparatus are anxious to compare their products with those of their foreign competitors, and no doubt the visitors from Europe will be glad to have an opportunity to join in the comparison. Both will derive benefits from such comparison, far superior to those gained through descriptions no matter how accurate. The same is true of all branches of industrial activity. It is therefore to be hoped that European manufacturers will join us heartily in displaying all that has been done toward advancing the application of electrical science.

TO the man of scientific tastes the observatory of an astronomer is always an object of interest, and even the ordinary mortal finds about the telescope a certain charm which, perhaps, is due to that natural desire to know something of, or at least obtain a glimpse of, worlds far distant. Few there are though, outside of those enthusiastic in this special work, who would investigate astronomical methods. The busy individual strictly electrical in his inclinations could hardly be expected to find much that was attractive in an account of spectroscopic research as applied in astronomy, but a realization of the important part which electricity plays in the investigations carried on in a Chicago observatory would undoubtedly insure the careful perusal of the article presented in another column. Kenwood observatory has already done good service. A visit and a few hours' association with the enthusiastic worker in charge, brings to mind not only the immense value of spectroscopic analysis in astronomy, but also the great field which exists for the application of the spectroscope in those arts that are now termed electrical. A line of research was pointed out; perhaps the idea was an old one or perhaps many are even now working quietly upon it. The thought was advanced that carbons could be greatly improved not only in the line of a decreased resistance but also in the direction of securing for the same electrical energy expended, an increase in the illuminating power of the arc. A metallic impregnation of the pencil was suggested as a means through which the end might be obtained, and it was indicated that through the help of the spectroscope the most accurate and satisfactory investigations in this line might be made.

As was stated, the idea set forth may not be a new one, but in our opinion, whether old or new, the suggestion is worthy of the most careful consideration of the carbon manufacturer. Now that refinement of products is the order of the day, the carbon man would profit by an improvement of the light of the arc. Research in this particular line would make exceptionally interesting reading.

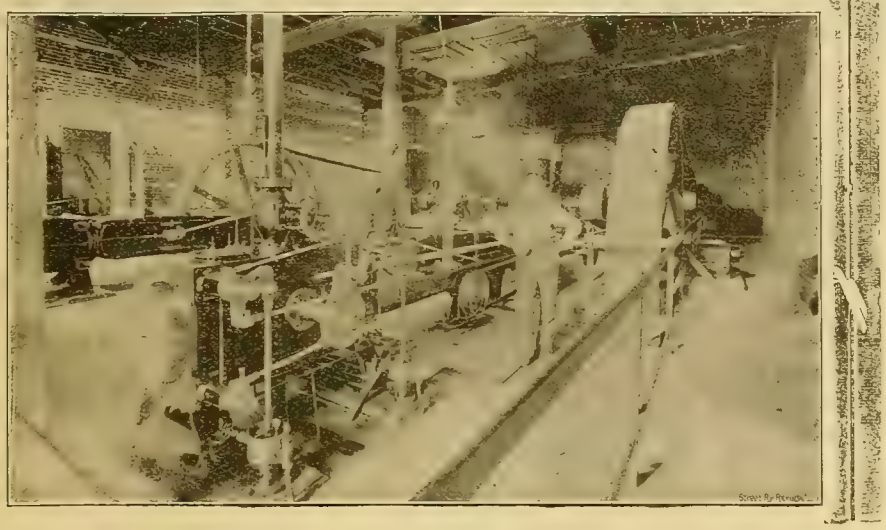
TWO of our English contemporaries—the *Electrical Review* and the *Electrical Engineer* of London—come to us this week with leading editorials contrasting the electrical progress of the United States and the United Kingdom to the manifest advantage of the former. The *Review* confines itself to electricity in mining operations, and, after pointing out the many varied operations grouped together in this country under the general title, "electric mining," continues: "Remarkable, indeed, is the enormous development which has taken place in the use of electricity for these purposes; and the substitution of electrical for steam or compressed air plant, which process is going on continually, shows conclusively that the American mine owners have learned that electricity is not only more economical but that it can be adapted to perform work in those parts of a mine where any other agency would be inadmissible. Why has not a similar development taken place in the United Kingdom, and are there any theories which can be advanced to explain the cause of the slow rate of progress made in this country? The answer is in the affirmative." The *Review* then explains that the principal reason why British mine owners object to electricity is because they consider it unreliable. English electrical engineers are therefore urged to endeavor to remove this erroneous impression. But to the American reader the question naturally suggests itself: Why did the American mine owners have little or no doubt as to the reliability of electricity? Can it be that our electricians have secured uniformly better results than their English co-laborers? An affirmative answer would seem to be the inference to be drawn from the *Review's* presentment.

The leader in the *Electrical Engineer* is on "American Statistics," and is a brief review of totals taken from census returns of electric lighting and railways. First preparing the way by the statement that "figures are proverbially misleading," the *Engineer* shows that for the last five years the average annual construction of electric railways in the United States has been 600 miles. On this the English paper comments as follows: "Turning from America to England, what has been the progress here? Certainly not at the rate of 600 miles a year, nor even at the rate of 60 miles. In fact, we have not 60 miles of electric tramways all told, and the difficulties those who attempt to exploit such work have to encounter are greater than those entailed by the mythical labors of Hercules." In electric lighting, we are told, the preponderance is not so greatly in favor of this country, although the figures "show what a vast electrical engineering industry has been created during the past ten or twelve years."

The comparison is certainly gratifying to our national pride, but numerical superiority should not cause us to relax in endeavoring to attain even better results in the future than those of the past that are to be credited with the wonderful growth of electrical industries.

Electric Railway at Keokuk, Ia.

Keokuk, Ia., is one of the most attractive and enterprising of the smaller western cities, and it is not surprising, therefore, that it should boast of an electric street railway distinguished alike for excellent equipment and good management. This line is owned by the Keokuk Electric Street Railway & Power company, which operates six miles of track. The illustrations, taken from the *Street Railway Review*, show the main line, on the principal street of the city, and the interior of the power house.



ELECTRIC RAILWAY AT KEOKUK.

Six vestibuled and four open cars, built by the St. Louis Car company, constitute the rolling stock. Each car is supplied with two 15 horse power Edison motors. As shown, the overhead single trolley system is used. The generators at the power station are driven by two Hamilton-Corliss engines of 125 horse power each.

The road has proved a great success and is pointed to with pride by the citizens of Keokuk. The officers of the company are: G. L. Reiner, president; H. C. Reiner, vice-president; W. J. Reiner, treasurer; O. J. Chapman, secretary and general manager.

Electricity in Iowa.

The Sheldon, Ia., *Eagle* gives a graphic description of a local event which occupied the attention of the social circles of that section. It was the ladies' band concert and broom brigade, and one feature of the entertainment is described as follows: "The representation of Bartholdi's Statue of Liberty in the final tableau was well worthy of the tremendous applause with which its appearance was greeted. Several attempts of a similar character have been made in different cities but nothing has ever been produced which in completeness of detail and effect could be compared to that of Monday and Tuesday evenings. An excellent choice was made in the selection of Miss Ethyl J. Davis to represent the Goddess of Liberty. Miss Davis stood on an elevated pedestal, her upraised right hand grasping a torch, capped with a cluster of lamps, which alone would have been sufficient to illuminate the entire room. A crown with a cluster of lamps, and covered with jewels, and her robes completely covered with incandescent lamps of various sizes and colors completed the costume. The lights in the hall were turned down and almost total darkness prevailed. As the contact was made bringing the electric lamps into circuit, the entire hall was illuminated with a flood of light which for amoment almost blinded the spectators, and Miss Davis, standing revealed in the glaring light, certainly presented a picture of unparalleled brilliancy and beauty." The good people of Sheldon have not had much experience with electric lights, it would seem, and they were amazed at what they considered the temerity displayed by the young lady.

The Transandine Railway.

The construction of the Transandine railway now under way in South America has furnished many intricate engineering problems, but probably the most interesting at the present time is the method of securing power for operating the drills in tunneling.

The length of the new railway is 149 miles, of which there are 109 on Argentine territory, starting from the city of Mendoza, 2,376 feet above the sea. In Chili there are forty miles, connecting with the Chilian system at Santa Rosa, 2,704 feet above sea level. The greatest height attained by the railway is 10,460 feet above sea level, the tunnel at that point being some two thousand feet below the summit of the mountains. There are eight tunnels grouped near the summit, aggregating 9.32 miles in length, the longest, the summit tunnel, having a length of 5.540 yards. To overcome a part of the difference in level within a short distance, and at suitable working gradients, it has been found necessary to construct a spiral tunnel 2,061 yards long, with a radius of 200 meters and a grade of eight feet in a hundred. It may be added that this grade is maintained through the whole nine miles of tunneling, except, of course, in the summit tunnel.

It had been decided to operate the drills by compressed air, and the question of securing power for the compressors became a serious problem. The engineers who had experience with the St. Gothard tunnel were consulted. They found it was impossible to procure fuel at the scene of operations, and the cost of transportation precluded the possibility of adopting steam power. Water power was next suggested, but this could only be had at a considerable distance from the point of operations. It was here that electricity was brought into use. Generating plants were installed where water power was available and the current transmitted to motors at the secondary stations where the compressors were required. It was found necessary to establish three plants, one upon the Argentine and the others on the Chilian side of the Andes. Both the Chilian installations are at Juncal. There are separate cables for transmitting the power from Juncal to Juncalillo and to Calavera, where the motors and air compressors are stationed. The power for driving the turbines is obtained from the Quebrada Juncalillo, the water being conveyed from the settling tanks to the turbines, a distance of about 1,420 yards by a double line of 20 inch steel pipes. The primary station at Juncal for this installation consists of six Girard turbines, each giving 80 horse power at a speed of 700 revolutions per minute. The total power of the turbines is therefore 480 horse power. Each 80 horse power is coupled directly to the shaft of an 80 horse power dynamo. The dynamos have an efficiency of 90 per cent. and an output of 135 amperes at 400 volts. They are arranged in groups of three. The secondary station at Juncalillo, where the motor and compressors are arranged, is about 3,281 yards from Juncal. The power available aggregates 401.8 horse power. At Juncalillo the cables are connected to six electric motors with a commercial efficiency of 90 per cent., making 361.67 horse power available at the point of operation. The motors, running at 600 revolutions per minute, drive through a shaft running at 300 revolutions and six air compressors operated at a speed of 180 revolutions per minute. Assuming the loss of power due to shafting and belting at 5 per cent., the power available for driving compressors is 343.58 horse power. The installation of Juncal Calavera resembles that at Juncal Juncalillo. The turbines are in the same shed and take their water from the same source. These and the dynamos are also of the same size and power, but since the distance between Juncal and Calavera is more than double that between Juncal and Juncalillo, the power available at Calavera for driving the compressors is proportionately less. There is a loss of 12 per cent. in the line. The power available at Calavera is 221.4 horse power. It should be mentioned that there are but four dynamos and a corresponding number of motors in this plant, two less than in the Juncalillo installation.

In the Argentine installation water power was furnished from Quebrada Navarro, the water being conveyed to the turbines a distance of 383 yards. Owing to the difficulties attending the transportation of machinery, it was found impossible to install eighty horse power machines in the plant on account of the great weight. Dynamos of half their size were finally adopted. At the primary station at Navarro four Girard turbines similar to those at Juncal are used. They are designed to work under a head of 377.3 feet. These develop 80 horse power at 700 revolutions per minute. Each turbine drives two 40 horse power dynamos directly from its horizontal shaft. The machines are grouped in pairs of two 80 horse power turbines with four 40 horse power dynamos. The turbines are supplied by one pipe. One group can be worked independently of the other, should any accident arise, provided it does not affect the source of the water supply. The primary dynamos, absorbing 40 horse power, have an efficiency of 90 per cent. with an electrical output of 250 volts and 107 amperes. The loss between Navarro and Las Cuevas, a distance of 3,000 meters, is 8 per cent. The 30 horse power motors at Las Cuevas have an efficiency of 89 per cent. The power therefore available for driving the compressors is 224.74 horse power.

ELECTRIC RAILWAY AT KEOKUK.

The several stations are connected by telephone, and similar communication is established between the settling tanks and the turbine house, so that although the works are widely separated, the same initial power which is, by the various processes, converted into active work at the rock face affords the means of instant and easy communication with all parts of the works. The workshops, which, by the way, are built of stone found in the district, with wooden roofs sent from England, are lighted by electricity generated by a separate 10 horse power dynamo.

Mechanical Telephone.

The accompanying cuts illustrate an improved mechanical telephone system for private

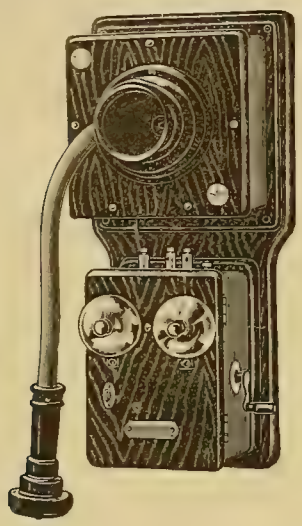
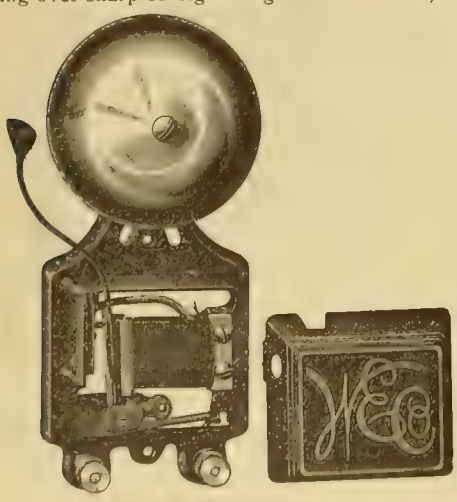


FIG. 1. MECHANICAL TELEPHONES.

lines. The many uses to which a system of this kind can be applied will be readily seen. It is intended for lines of one mile or less, but it is claimed that it may be operated even at greater distances when the conditions for line construction are favorable. The working parts are inclosed in a handsome polished, hard oil finished case, as shown in Fig. 1, and all metal parts are nickeled. Connections are provided for ground wire and lightning arrester, and if de ired attachment can be made with electric bells, burglar and fire alarms.

Fig. 2 shows an insulator, which it is claimed is also desirable for electric telephone lines. It is made of rubber incased in a metal shell that thoroughly protects it from the weather. From the rubber hangs a galvanized wire hook, through which passes the line wire as shown in the engraving.

Another device, shown in Fig. 3, is the angle insulator. The difficulty experienced in working over sharp or right angles is overcome, it



CHICAGO IRON BOX AND BELL.

is claimed, by using the device shown, which is made of two single insulators, pivoted to a malleable iron yoke.

The system, known as the Standard telephone, is placed on the market by the Bostwick & Burgess Manufacturing company of Norwalk, O.

An extensive deposit of mica, so largely used for insulating purposes, has been found near Marion, N. C.

Chicago Iron Box Bell.

The Chicago iron box bell, shown in the accompanying cut, is placed on the market by the Western Electric company, Chicago. This bell is simple, compact, and contains many desirable features,among which are the shape and position of the magnets, which, it is claimed, give the maximum power with the minimum of battery force. With one cell of battery this bell will ring through from six hundred to eight hundred feet of No. 18 wire, and for any ordinary call but one cell of battery need be used. The hammer and armature are made from a single punching, which is copper plated to prevent rusting.

Railway Telegraph Superintendents' Convention.

The tenth annual convention of the National Association of Railway Telegraph Superintendents was held at Cincinnati, O., June 17 and 18, President Geo. T. Williams of Cleveland in the chair.

The following delegates answered to roll call: Pres G. T. Williams, Nickel Plate Ry.; Sec. and Treas. P. W. Drew; C. Seldon, B. & O. R R.; A. R. Swift, C. R. I. & P. R. R.; C. W. Hammond, Mo. Pacific; M. B. Leonard, C. & O.; C. S. Jones, Ill. Central; C. A. Darlton, R. & Danville; G. L. Lang, N. Y. & N. E. R. R.; G. M. Dugan, Ill. Central; T J. Higgins, C. C. C. & St. L. R. R.; H. K. Brilland, M. K. & T. R. R; H. C. Sprague K City, Ft. S. & M. R R.; N. J. Frey, C. M. & St. P. R R.; C. H. Smith, I. J. & I. R. R; A. R. Lingafelt, C. R. I. & P. R. R.; Robt. Stewart, C. R. R of New Jersey; H. C. Reed, M. L. S & W. R. R; J. B. Stewart, West Shore R R; J. W. Stacy, Tex. & Pac. R R.; W. C. Walstrum, N. & W R. R.; T. U. Parks, I. & G N. R. R.; S S. Bogart; R. G Danley, C. H &. S R R; A. Hayward, O. & M. R R.; F. M. Duncan, O. & R. G. R. R.; K. McKensie, M. & O. R R; F. W. Wilson, G. R. & I. R. R.; J. L. Dobson, C. H &. D. R. R.; H. C. Hope, C. W. P. M. & O R. R.; Horace Johnson, B. & O. S. W. R. R; E. R. Adams, P. & R. R. R.; W. B. McFarland, F. E. & M. V. R. R.; J. R. Kimball, B. & O. R R.; W. P. Ward, B. C. R. & N. R. R.

The annual report of the secretary and treasurer showed the association to be in a prosperous condition. Communications were received from the Western Union and Cincinnati & Suburban Telegraph companies offering the association the use of their wires throughout the session.

The committee on entertainment submitted several plans. It was agreed to take a trip to Cincinnati's summer resort, including a twenty-mile ride on the Ohio river, a visit to the Zoological gardens and a trip to Woodsdale Island Park, about twelve miles out on the C. H. & D. R. R..

The annual election of officers resulted as follows: President, C S. Jones, Illinois Central, Chicago; vice-president, L. H. Korty, Union Pacific, Omaha, Neb.; secretary and treasurer, P. W. Drew, Chicago, Ill.

An invitation from the mayor of Denver and the governor of Colorado to hold the convention at Denver was read. The invitation was accepted. The president appointed A. R. Lingfier, C. R. I. & P. R. R., C. G. Sholes, A. P. & S. F. R. R. and F. M. Duncan, D. & R. G. Ry. a committee on arrangements for the convention at Denver. H. C. Hope, W. J. Frey and Robert Stewart submitted resolutions on the death of W. E. Lewis late superintendent of telegraph of the Long Island railway, which were adopted. A telegram was received from the Train Dispatchers' association in session at Toledo, Ohio, wishing the superintendents' association a pleasant and profitable meeting. An amendment to the constitu ion, to change the amount of the annual dues from $3 to $5, was adopted unanimously.

Most of the afternoon session was devoted to a discussion of labor questions—union and non-union employes—but no action was taken

W. W. Nichols and W. G Patterson were elected honorary members

Thursday morning was devo'ed to an examination of the exhibits. In the afternoon another session was held at which the following named persons were admitted to membership: H. G. Adams, B. & N. R. R., Alliance, Neb.; J. H. Jacoby, Lehigh Valley R. R., South Bethlehem, Pa.; W. P. Ward, B C. R. & N. R. R., Cedar Rapids, Ia; A D Halliday, D. & I. R. R., Two Harbors, Minn.; J. P. Boyle, K. & W. R. R., Centerville, Ia.; W. P. McFarlane, F. E. & M. V. R. R., Omaha, Neb.; G E. Evans, L. & N. R. R., Louisville. Ky.; E. R Adams, P. & R. R. R., Reading, Pa.; C. G Sholes, A. T. & S. F. R. R., Chicago, Ill.; R. McKensie, M. & O. R. R., Reading, Pa.; W. D. Vincent. B. & O. R. R, Pittsburg, Pa.; J. M. Egan, S. & S. F. R. R., Springfield, Mo.; R. J. M. Danley, C. S & H. R. R., Columbus, O; J. R. Kimball. B. & O. R. R., Newark, O.; A. Hayward, O. & M. R R., Cincinnati, O.; E. R. Scoville, B. & O. S. W. R. R., Chillicothe, O.; H. G. Johnson, I. I. & I. R. R, Kankakee, Ill.; F, M. Duncan, D. & R. G. R. R., Denver. Col.; W. W. Jackson, N. Y. & N. E. R. R., Providence, R. I; J. W. Dawson, K. & N. M. Ry., Charles town, W. Va; F. Peters, Southern Pacific Ry., New Orleans, La.

The following paper on "Care and Maintenance of Block Signals" was read by G L. Long, superintendent of telegraph of the New York & New England Railway:

Care and Maintenance of Block Signals

BY G. L. LONG.

Electric signals for keeping trains a certain distance apart, commonly called block signals, are slowly but surely coming into use. The very able and exhaustive paper read by Mr. Stewart before this association last year has placed before us the several systems in use. Other papers have called attention to the use and value of such signals, but no one has given us even a hint as to what was necessary to make these signals effective after they were once placed in position on a railroad. I find the usual condition to be about as follows: Some smooth-tongued representative of one of the various signal companies will secure an interview with the general manager, usually selecting a time when the recollection of an accident is fresh in his mind, and show him how the use of his system would make such an accident impossible. Cost of app iances and cost of erection are shown to be nothing as compared to one first-class "tail-ender." No argument is necessary to demonstrate the value of such appliances, so the matter settles itself into a question of cost. Ordinarily not a word is said about the cost of maintenance, so the official gets the idea that when once equipped with signals there will be no further

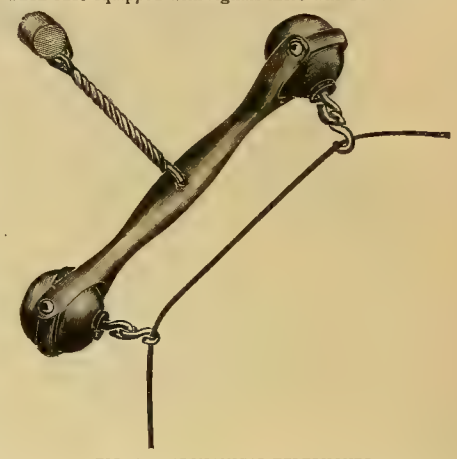


FIG. 3. MECHANICAL TELEPHONES.

cost, that the signals will run themselves, so to speak, displaying automatically and continuously almost the intelligence of a human being. The signals are ordered placed in position and are found to work splendidly. Soon engineers begin to report signals out of order, standing at danger improperly. The road master, who is probably notified, knows no more about it than a child, except that he knows it is "electric." The matter is then referred to the telegraph lineman, who knows little more than the road, master. The result is that scon all the signals are at danger, and the company putting them in is notified that the signals are a failure. Upon investigation the signal company usually finds the whole trouble to be a want of care. Thus we see that the signals have a bad reputation through no fault of their own, while the general manager discovers that the first cost is but the beginning of the expense. What I say may have a strong "chestnut" flavor to most of you, but knowing how many comparatively simple things I had to learn or had to learn to apply when I commenced the care of signals I venture to mention a few of the points where trouble is apt to appear. As my experience has been mainly with a battery signal what I say will more particularly have reference to the systems using a battery.

First of all select an intelligent man to take care of your signals and impress upon him that eternal vigilance is the price of a perfect working signal. He should clean the battery zincs very often to keep the internal resistance at the minimum, the external resistance being merely nom-

FIG. 2. MECHANICAL TELEPHONE.

inal. A point not generally understood by battery men is that a battery that will work a four ohm sounder for two weeks will work a signal circuit of half an ohm resistance only one week. When the zinc becomes reduced one-half, in size we do not notice it on a circuit of high resistance but it is fatal to a circuit of low resistance. In our service we had two circuits of different resistances, one from half an ohm to two ohms; the other from ten to twenty ohms. We transfer the half consumed zincs from the low to the high resistance circuit, keeping up the efficiency of both batteries. Before leaving the subject of

batteries I want to say that fully nine tenths of the failures recorded on block signals can be legitimately charged to the battery, showing that this is the main point to watch. Another point which, if carefully and intelligently watched, will save much anxiety and search for cause of trouble is the relays. Every relay should be hermetically sealed so that no dust can prevent the points from making a sure and perfect contact or connection. Every relay should be protected by a lightning arrester of some kind since, strange as it may appear, relays in a circuit made up of the steel rails of the track and underground wires with no air line wire whatever are often burned by lightning. Where the track is used for part of the circuit the joints are usually bridged by wires fastened to the rails by rivets driven into holes drilled for the purpose.

This is something that requires very close watching. The track workmen are often ignorant, careless, or both, breaking the wires or loosening the wires on the rivets.

A detecting galvanometer is a very valuable help in locating faults of this nature.

In systems using the tracks for circuit, insulations are necessary to divide the track into suitable signal sections, as well as for other purposes.

These require great care in first introducing as well as careful watching from day to day. The insulating material may be of wood, vulcanized fiber, leatheroid laminar fiber or other suitable material. The exact manner of introducing these insulations varies on different roads. The cost per signal for maintenance of double track block signals is about $40 per annum, varying somewhat according to the traffic. Notwithstanding the expense of installing a complete signal system and the expense of care I believe their use to be an economy when the traffic is as heavy as is the case on some parts of most of our leading railroads. By the aid of these automatic signals, trains are run into and out of our cities safely at intervals of one, two or three minutes, regardless of fog or weather. Without signals this could not be safely accomplished.

As I remarked in the beginning, the perfect working signal displays intelligence little short of human—never sleeps on duty and never gets drunk

In the discussion which followed it was stated that the first quadruplex system had its origin in Cincinnati in 1858, Dr. Nicholson being the inventor.

W. W. Nichols and N. G. Patterson were elected honorary members of the association.

The exhibits, while not very numerous, made a very good showing. The Electric Secret Service company had in operation a Ward lock, a Ward repeater, Edison Leland batteries and Edison phonoplex system. Alexander & Hill had a system of locks. Stewart & Hall had a train order signal, I. N. Miller of Cincinnati had a lightning arrester. The Union Switch and Signal company, represented by Chas. A. Scott, displayed an electro-semaphore mechanical signal using a combination with a single color for block signal use or for stations.

The Chase Electric Railway Signal company showed a crossing signal.

The Electrical Supply and Manufacturing company of Cleveland displayed an O'Neil automatic crossing.

Harvard Electric Club Election.

At the annual election of the Harvard Electric club the following named officers were chosen: President, G. S. Curtis, '92; vice-presidents, C. H. Arnold, '92, and P. L. Spaulding, '92; secretary, T. Hoppin, '93; treasurer, H. C. Smith, '93; librarian, P. W. Davis, '93; members at large of executive committee, G. T. Page, '92, C. H. Arnold, '92 and H. Gregory, '92.

Massachusetts Municipal Lighting Act.

The Massachusetts legislature has passed and Governor Russell has signed the so-called Municipal Lighting act. The cities and towns complying with the prescribed conditions will have the power to supply gas and electricity to inhabitants. The Massachusetts legislature seems to have been conscious that a law empowering municipalities to assume functions so far transcending the ordinary limits of municipal activity in this country should not be taken advantage of too easily.

Towns may proceed under the act when two successive town meetings, the second of which shall be held within not less than two nor more than thirteen months after the first, shall have so decided by a two thirds vote. If a two-thirds vote is not obtained at the second meeting, another vote cannot be had within two years. In the case of cities, a two-thirds vote of each branch of the city council, approved by the mayor, is required for two consecutive years; and this vote of the council must be confirmed by a majority of the voters at a municipal election. If a popular majority is not obtained, the proposition cannot be submitted to the people again for five years. The cost of construction or enlargement of municipal gas and electric plants is to be defrayed by the issue of 5 per cent. thirty-year bonds to an amount not exceeding 2½ per cent. of the assessed valuation of the town or city. Money may be borrowed for operating expenses. These, depreciation of plant, interest, and the annual contribution to the sinking fund for the redemption of the bonds at maturity, must be included in the annual appropriation bills. The cost of construction and maintenance will be assessed upon owners or occupants of real estate. Payment of assessments is made voluntary, but gas and electricity will be supplied only upon payment. A manager, appointed and removable by the selectmen or the mayor, will have entire control of the plant and all business connected therewith. The price of gas and electricity cannot be put below cost, save by permission of the gas and electric light commissioners, and shall not be changed oftener than once in three months The city or town shall pay only cost price for gas and electricity used by itself. In no case is the profit upon the investment to exceed 8 per cent.

On account of the large amount of capital invested in private corporations for the supply of gas and electricity the provisions in regard to the purchase of private plants are of special interest. A city or town which has been authorized to establish a plant, shall before proceeding to do it, purchase at a fair price only the plant of private parties engaged in furnishing gas or electricity, or both, within the limits of such city or town, provided the owners choose to sell.

If the cities of Massachusetts decide to go into the manufacture of gas and electricity, the private companies, however great their resources, their profits, and their expectations of future profits, cannot compete with them, but will have to make the best terms possible and retire from the business. The Massachusetts towns and cities may be reluctant about adding to their indebtedness the sums required for the purchase or establishment of gas and electric plants, but the prospect of gas and electricity at cost is alluring. Whether that cost can be kept down or not will depend upon the aptitude, intelligence, and honesty of the managers appointed by the mayors and selectmen. It has not been found usually that public corporations are better served in matters of business than private persons; and the Massachusetts municipalities that engage in the gas and electric business will take a considerable risk. If, however, they should be able to furnish gas and electricity at prices considerably less than those prevailing under private management, and still should be able to show a profit, or only a nominal loss, we may expect to see further intrusions of the government, municipal, state and national, into what is now the domain of individual enterprise.

An Alternating Current Motor.[1]

By A. L. Kuehmsted and Henry Floy.

The extensive introduction of the alternating current for electric lighting, and the flexibility of the system when used with transformers, has caused an imperative demand for an efficient and commercially convenient alternating motor.

For many purposes the synchronous type of motor would fulfill the above conditions if it were possible to put the same "in step" with its generator, without making use of some of the various but decidedly objectionable forms of "starting motors." With the idea of overcoming most of these objections, the authors constructed a two wire alternating motor, based upon a novel and unique theory, primarily suggested by Prof. H. J. Ryan.

It is a well known fact that should a motor have its armature wires closed on themselves, and one set of its fields excited by alternating current differing by a quarter phase from another current exciting the other set of fields, rotation of the armature will ensue. Now if instead of two currents, the same current excites both sets of fields, but the magnetization of one of the sets is caused to lag ninety degrees, or approximately thereto, by means of mutual induction, we shall have conditions similar to the above case and hence a revolution of the armature.

For one motor, four horse shoe magnets, *A*, *B*, *C* and *D*, each of nine square inches face, were built up of tin plate to avoid Foucault currents. About two magnets, *A* and *B*, were wound, separately, 200 turns of No. 10 B. and S. insulated copper wire, which when short circuited on itself would, through metal induction with the exciting coil, cause a lag of about 90° in the magnetization of its core. Insulated, instead of naked copper wire, was used for short circuiting coils in order that the electrical forces therein might be controlled and measured. The magnet *C* was then put on top of *A* and *D* under *B*; about each of the two compound magnets thus formed was wound in three sections 290 turns of No. 10 B. and S. insulated copper wire to serve as exciting coils. The magnets were then placed facing one another and secured to a cast iron base, the wires properly connected to binding posts, etc

The most unique feature of our machine was its armature. This was simply a copper disk nine inches in diameter and one-quarter inch thick; thus acting as a huge closed coil copper conductor of one turn. The disk, supported by its shaft, was so placed between the poles of the two compound magnets that the lines of magnetization between the poles of the same magnet would cut it.

The two compound magnets are only additive in effect. Considering only one of them, *i. e.*, *A C*, the action is as follows: An alternating current cut through the exciting coils sets up magnetization in both magnets *A* and *C*. Thus the magnetization in *C* is practically in unison with the current, while in *A* the magnetization lags nearly 90° behind that of *C*, because it is necessarily 90° behind its current, which is practically in unison with the magnetization of *C*. Thus the magnetization in one magnet is a maximum when the magnetization in the other is a minimum, and vice versa, the rate of change being of course greatest at its zero value. The copper disk being between the poles of both magnets will have e. m. fs. set up therein, due to the varying lines of induction.

If the magnetization of *C* is at its maximum, that of *A* will be zero and the currents set up in the disk will be repelled by the maximum magnetization, thus causing the disk to revolve. At the next instant, when the magnetization of *A* is a maximum that of *C* will be zero, but with its greatest rate of change, and in the same direction just had by the magnetization of *A*, hence currents are induced in the disk in the same direction as before; but the magnetization of *A* being of the opposite sign, there will be an attraction, which will tend to drive the disk in the same direction as before, thus continuous rotation is produced, and is due to rotating polarity of the field magnets.

The motor was first connected with the Westinghouse alternator, giving a constant current of ten amperes. The disk was heated but did not revolve.

By experiment it was found that the magnetization was arranged in the respective fields as theory dictated, but weak in the magnets inclosed by the short circuited coils. This was remedied by putting in series with the coils a large resistance, which brought up the magnetization, but even then the disk would not rotate. This showed that the fault was in the disk itself. By a series of computations it was found that the currents generated in the disk amounted to perhaps 100,000 amperes, which accounted for the rapid heating of the same. With such an enormous current the self induction was so large as to counterbalance the effect produced by the fields. Substituting a copper disk $\frac{1}{32}$ inch in thickness for the original armature, rapid rotation was secured, but here further experiment had to end owing to lack of time, leaving two variables to be "felt out:" First—the exact thickness of the disk to secure best results. Second—the proper resistance in the short circuiting coil to secure just the right magnetization in the magnet.

[1] Abstract of Report of Experiments at Cornell University.

The Blackening of Incandescent Lamps.[1]

By Legh S. Powell.

The references which have lately appeared in the *Electrical Review* relative to the depreciation in the illuminating power of incandescent lamps through blackening, and its consequent bearing on the economic length of time that lamps should be kept in use, have a peculiar interest to those who have made this department of electric lighting a special study. The tables given on page 621 of your issue for May 15th show clearly the different degrees of darkening tendency which lamps of different manufacture possess. It is not forgotten that other causes besides blackening contribute to diminish the illuminating power, but in most lamps, at least, the one under consideration is the most influential. To the manufacturer of lamps, then, this blackening feature is naturally one of the utmost importance, since in this direction lies one of the principal possibilities for further improvement. Formerly the writer was of opinion that the problem of diminishing this blackening tendency was about on a par with that of attempting to prevent water from boiling when a kettle of it is placed over a fire. But the two cases are scarcely parallel, for it is an undeniable fact that blackening occurs in very different degrees, not only in lamps of different manufacture, but even among their own kind. A good deal of the variation, no doubt, occurs through differences in the temperature of the respective filaments, but this cause is certainly not the only one at work. Much of the difference is attributable to the manner in which the carbon filament has been treated during its manufacture, and this fact raises the very interesting inquiry as to what cause the blackening is due, and wherefore there should be these differences in intensity.

To the writer there appear to be two possible explanations to account for the blackening phenomenon: One is the generally accepted view of the vaporization and sublimation on the glass of carbon, pure and simple; the other, that the obscuring substance may possibly not be pure carbon but a hydro-carbon, or some allied carbon compound.

Probably every lamp manufacturer is familiar with the fact that lamps made with filaments which have been "baked" at a comparatively low temperature blacken very readily indeed, while when made with others which have been raised to a very high temperature, they resist the tendency very much more effectually. Further, that the same results occur in lamps when low or high temperature flashing has been employed. He is also very familiar with the effect of different temperatures on the hardness of the resulting carbon. If then the vaporization of pure carbon be the true explanation of the darkening of lamp bulbs, it follows that the difference in degree must arise solely from the circumstance that a comparatively loose condition of the carbon is especially favorable to the formation of carbon vapor. But the production of carbon at a low temperature would also be especially favorable to blackening, if the hydro-carbon view is the correct one. The writer can well remember when attending Dr. Frankland's lectures on chemistry, being impressed by that gentleman's assertion that to produce pure carbon by any of the usual methods is almost an impossibility, and that to free it from the ever present combined hydrogen, it is necessary to heat it in chlorine gas for days. That all hydro-carbon compounds are eliminated from the filaments in ordinary use is, therefore, extremely doubtful. In further support of the view that the presence of hydrogen may exert an influence in the feature of blackening, the fact may be cited that filaments of carbon baked at a low temperature become materially harder in process of running lamps made with them, and yet the rate of blackening, instead of diminishing, seems to proceed at an accelerating rate. It would be most interesting if those who have the opportunity would collect and thoroughly examine the composition of the deposit which collects on lamp bulbs, and thus throw valuable light on this interesting subject, and in addition, direct the steps of the pioneer lamp manufacturer into a track which is likely to lead to a material decrease in this unfortunate property of lamps. To carry out the work satisfactorily, it would be necessary to examine the deposit obtained from lamps from various sources, and then, should it prove to be other than pure carbon, to further ascertain, if possible, the treatment the respective filaments have been subjected to. The latter undertaking would, probably, be the more difficult of the two, considering the commercial interests at stake. It may be mentioned that the obscuring film is readily removed from the glass by means of a little warm caustic soda solution. Also the fact that the film is a sufficiently good conductor of electricity, even when faint, to become coated with copper when a piece of the glass is made the cathode in a copper plating bath. It is possibly due to this fact that an incandescent lamp acts as such an excellent condenser.

It is interesting to speculate as to how the obscuring matter, whatever it may be, finds its way from the fila-

[1] From the London *Electrical Review*.

ment to the glass. It is conceivable that there may be three methods by which the transfer can be effected: Firstly, by the direct formation of a vapor, as in the case of the vaporization and sublimation of arsenic; secondly, by the solution to saturation of the matter in the residual gas and subsequent precipitation therefrom on the neighboring cold surface, as instanced by the solution of water in warm air and its re-appearance on a window or other cool surface; thirdly, by the mechanical emission of solid particles. From a consideration of specimens of blackened lamps, it is difficult to determine which of these methods is the true one, or whether two or more methods combine to effect the transfer, because, in vacuo, the conditions of matter are so materially altered in so many essential details from those with which we are ordinarily familiar that arguing by analogy becomes impossible. But whether the transfer is effected by gaseous or solid particles, we may note certain very significant effects. The sharply defined uninterrupted circular line of slightly tinted glass, so distinctly visible by daylight in every well blackened lamp whose Ω-shaped filament is perfectly symmetrical, tells a peculiarly interesting tale. There can be no doubt that this half-colored line is caused by the limb of the filament nearest the glass acting as a screen to the emissions of the more distant one. In other words, the projected particles of only one of the limbs can strike against the light colored strip, because just there the further one is hidden, whereas in every other part of the bulb they can, and do, strike from both limbs, and consequently at all these other parts the glass is colored to twice the depth of the screened portion. Another notable effect is that of the patchy, unequal blackening which occurs in the bulb of a lamp whose filament develops a bright spot, the glass in the neighborhood of the spot being the darkest part. The same thing happens when the filament is bent so as to stand appreciably out of the center of the bulb. From these observations it is perfectly clear that the matter, whether in the form of vapor or solid, is in the radiant condition, and that there is no turning of corners for it. The particles fly direct from the filament to the glass and there adhere to it and to one another as firmly as do the particles of copper on the cathode of an electro-plating arrangement; and further, they appear to follow the same law as light, in its property to decrease in intensity with the distance from the issuing point. It naturally follows from this consideration that for a given size of filament, the larger the bulb the less the amount of blackening, other considerations remaining the same.

As regards the remarkably coherent black film, it may be remarked that if it is built up by the accumulation of countless solid particles it would entail that carbon is possessed of far more of the soft, doughy property of lead or wax than one is apt to attribute to it. The principal causes assisting to bring about the cohesion, assuming this view to be correct, are, no doubt, the probable enormous velocity with which the particles travel, and the freedom from any foreign matter acting to interfere with the intimate contact of such particles as they collect.

Referring to the economic length of run that a lamp should have, it seems to the writer that any particular number of hours arrived at by calculation, can only hold good in a general sense, for the reason that lamps do not all blacken equally in the same time. Probably the actual run that lamps will have, in private houses at any rate, will be determined by the inconvenience experienced from an insufficiency of light rather than by any other consideration.

A Rough-and-Ready Dynamometer for Small Motors.[1]

By John Hoskin.

I have been requested to bring to your notice this evening a friction-brake dynamometer that is by no means new, but is one that is deserving of being more widely known by electricians than appears to be the case.

Like the well-known Prony brake it acts as an absorption dynamometer; and without detracting from the acknowledged value of this instrument, especially for testing the value of large prime-movers, yet we need something more portable, more convenient to use, in the very numerous cases where it is desirable to test the efficiency of small motors.

We need a rough-and-ready instrument that is portable, inexpensive, readily used, and at the same time reliable.

This we find in a friction-brake dynamometer, one of the many modifications of those illustrated by William Worby Beaumont, in his paper on friction brake dynamometers, read before the Institute of Civil Engineers in London, November 13, 1888, and published in 1889 in the proceedings of the institution.

Its construction requires only the use of a leather belt with a spring balance attached to one end, and a suitable weight at the other. The belt is to be thrown over the belt pulley of the motor, the spring balance is fastened to the floor base or support of the motor to be tested, and the weighted end hangs pendant on the side of the pulley which, when in motion, will tend to lift the weight. When the motor is at rest, the strain of the weight should be read off on the spring balance. This reading we will call W. When the current is switched on and the motor runs at speed, the spring balance should again be read off, since the friction of the pulley on the belt will have a tendency to raise the weight; this reading we will call W'. The difference between W and W' in pounds, multiplied by the circumference of the pulley in feet (including one-half the belt thickness on each side), and this by the number of pulley revolutions per minute, will give the foot-pounds of mechanical energy, which can be compared with the electrical energy required to produce it, in the usual maaner.

Thus, in a few minutes with the aid of a speed counter or tachometer, a voltmeter and an ammeter, the efficiency of a motor can be determined, and its ability to do a desired amount of work ascertained at once, instead of being left to guesswork, as would often be the case if more bulky or elaborate apparatus were needed.

It should not be imagined from these remarks that this form of dynamometer is applicable to small motors only; but it is evident that for testing larger machines where many horse power have to be measured, the apparatus needs more elaboration, especially in the use of friction blocks under the belt or pulley strap, their lubrication, and the use of a dash-pot to steady the brake when the motive power is irregular.

But I need not enlarge on this, except to say that in these particulars, whether using steel strap or leather belt with friction blocks, or rope friction, the same care is needed as in the Prony brake to obtain correct readings.

Before concluding, I submit to your consideration the value of the Waldron rotary pump for use as a dynamometer, although I have never heard that it has been applied to that purpose. In examining one of these engines recently for other purposes it occurred to me that it would serve as an excellent dynamometer.

This pump is operated by rotary piston blades working in a chamber, without leakage, and with but small friction, the amount of which can readily be ascertained and calculated for use as a "constant." Its capacity per revolution, and the number of revolutions being known, as also the pressure against which it works, which can be regulated by a pressure gauge, the foot pounds of work is at once arrived at.

This method of measurement will correctly register the work done, although the speed may be irregular; and its results can be made more accurate than that of the friction dynamometer, because not subject to the irregularities arising from differences in lubricants, temperature, etc., which make it necessary to use adjusting screws in most forms of friction-brake dynamometers.

[1] Read at the meeting of the Electrical Section of the Franklin Institute, May 5, 1891.

CORRESPONDENCE.

New York Notes.

New York, June 20.—The legal representatives of Joseph Wood, now under sentence of death, are persistent in their efforts to save his life. They have thus far evaded execution of sentence through technicalities. The course pursued has greatly vexed the judges before whom the motions and appeals have been made, and the lawyers have been threatened with disbarment if they persisted in reckless evasion of the law.

A new plan was adopted this week, however, when it was decided to appeal to Gov. Hill for executive clemency. It is hardly possible that this will succeed, and if it does not Wood's counsel says he will once more endeavor to have the case re-opened, and if necessary go through the same course as heretofore.

The passage of the electrical execution law has not served its purpose in this state. Juries seem disinclined to return verdicts that will consign the prisoners to untold suffering, and when convictions are secured it seems impossible to execute them. Kemmler, thus far, is the only murderer executed in this state since the enactment of the electrical execution law.

Rapid transit and discussions over the possibilities of the several proposed systems continue to occupy the attention of the electrical engineers and a large proportion of the community. Last week the *Sun* expressed its doubts of the ability of an electric motor to draw a loaded train of six cars at the rate of forty miles per hour. This was promptly met by a challenge from Frank J. Sprague, who expressed a willingness to put $50,000 on the result.

The Johnstone Underground Construction company of this city has been incorporated under the laws of West Virginia, with a capital of $1,250,000. The incorporators are: C. W. Meade, D. M. Hildreth, Jr., and Percival Farquhar of New York City; Carl Edelheim and Geo. R. Thompson of Philadelphia, Pa.

Severe electric storms in this vicinity have played havoc with electric conductors, the telegraph and telephone companies sustaining the most damages. J. L. B.

Cincinnati, O.

Cincinnati, O., June 20—During a severe storm a few days ago lightning struck the lines of the Cincinnati Electric Light company, and was carried into station A at the corner of Front and Rose streets, completely ruining a $10,000 Slattery alternating dynamo, and crippling the plant so that it will be several weeks before things can be put in shape again.

The Edison Electric company is pushing the work on its underground system in this city, having completed up to date about 15,000 feet in the principal streets in the center of the city. Work on the station is being pushed forward vigorously, The company expects to be in operation by October 1. It gained the fight with the gas company, and all the numerous injunctions have been disposed of so that no obstacle to the success of the company is now interposed.

A new electric road is to be built up Liberty street hill by the Mt. Auburn Electric Railway company of this city. General Manager H. M. Littell says that if the right of way can be secured within the next thirty days, the road will be in operation before winter. His company has the money ready for the enterprise, which it prefers to building another inclined plane, as had been contemplated. The edison single tr lley system will be used.

The F. B. Morgan Electric company, organized some weeks ago, has a plant in operation at 64 Produce street, and reports flattering prospects for the future. It has been in operation but one week, and is furnishing 75-horse power on motor circuit, and about 300 16-candle power incandescent lights.

Campbell Scott, agent for the Edison General Electric company, reports having secured the contract for wiring 700 lights in the Middletown Opera House at Middletown, O., and for wiring 600 lights in the Young Men's Christian Association building, Cincinnati, and $30,000 worth of handsome fixtures have been sold to the St. Nicholas Hotel in this city. Altogether, it has been a very good month for the company.

Post & Co., who have only recently taken hold of the electrical supply and construction business, have secured the contract for wiring the new addition to the St. Nicholas Hotel, this city. O. H. Hubbard, formerly with the central district of the Thomson-Houston company, has charge of this branch of the business.

W. H. Reynolds of Washington, D. C, has about perfected a converter for use on direct high tension circuits. It is so constructed that only the amount of current actually used in the lamps burning is taken from the circuit.

The Mt. Adams & Eden Park Railway company has about completed the change from horse cars to the electric system. The cars and apparatus are all on the ground, and in position, and will probably be running by July 1. The company uses the Thomson-Houston double trolle system.

The Edison Electric company of this city has closed a contract with the management of the Street Railway company of Hamilton, O., to equip its cars, electrical apparatus, etc. Five miles of line are to be operated and the work must be completed before July 1. G.

Indianapolis, Ind.

Indianapolis, June 20.—Officials of the Broad Ripple Electric line report that nothing has been heard from the Edison company during the past week. All work is at a stand still on that line, and the time for its completion is short, as the franchise will soon expire. The route for the New North Indianapolis Electric line has been selected and work begun; it will be a branch of the Illinois street line.

The Citizen's Street Railway company has borrowed $500,000 to build and equip the additional electric lines now laid out. A mortgage on its property was filed to-day to secure the loan

Charles Reitz, an Indianapolis electrician, has been at work for some time past on an electric buggy, which is about completed. In it he has a small motor and thirty cells of storage battery, with which he expects to run the buggy for eight to ten hours without recharging. The outfit complete will weigh between 400 and 500 pounds, and will soon be ready for a practical test on the street.

A special meeting of the city council was called for to-night and it was the intention to introduce an amendment to the ordinance which calls for putting electric light wires underground inside the original plat of the city, changing it so as to allow the putting in of a plant for the city and stringing wires on poles, as it has been figured there would be a saving of nearly $100,000 in cost of putting in such plant. As there was not a quorum present, nothing was heard of the amendment

To-morrow the Board of Public Works will open bids for lighting the city, if any are received. None have been received by the board up to present time. M.

Sioux City, Ia.

Sioux City, June 20.—Court street is the now proud possessor of an electric street light.

It is generally understood th t the Booge and Taylor and Peavey Street railway interests have consolidated.

The telephone company had several instruments burned out by one of its wires coming in contact with an arc light.

The preparations for the fifth annual festival of the Sioux City corn palace are already under way. The festival will be opened October 1st, and will continue until the 17th. Electric lighting will, of course, be utilized, and there will be an immense plant installed. The lighting effects secured last year at the corn palace were the most wonderful features of the exhibition. W. H. T.

San Francisco, Cal.

SAN FRANCISCO, Cal., June 18.—Colonel R. C. Clowry, vice-president of the Western Union Telegraph company, with a party of other telegraph officials, has been in San Francisco during the past week on an annual tour of inspection. The party came by way of Southern California in order to follow the extension of the coast line of the Southern Pacific from Santa Barbara to San Francisco. This new line, which is about finished, will afford additional facilities for business to Los Angeles, and to the East by the southern route. In speaking of the progress made in the art of telegraphy during recent years, Colonel Clowry said: "There is a difference now between the speed with which messages are transmitted and that of 1881, when I first came out here. Then we had to have all matter repeated at Ogden, Cheyenne, Omaha and Chicago, while now we work direct from San Francisco to Chicago, and sometimes when conditions are favorable, with New York, thus reducing the actual time consumed from an hour to half a dozen seconds." "When I first came out here in 1863," remarked Superintendent Jaynes, who was present, "a merchant sent a message to New York one morning, and received a reply the next afternoon, and so highly was the feat thought of that the papers wrote commendatory articles on the great progress California was making. Now we can handle the same business in an hour."

It is evidently the intention of the San Francisco and San Mateo Electric Railway company to make its line run as far south as possible with the ultimate purpose, it seems, of making San Jose the terminus of the road. The last step taken in this direction was the securing of a franchise from the board of supervisors for an extension of the line from Baden through San Mateo to Redwood City. This adds about ten miles more to the road, making the total length nearly 24 miles. It is stipulated in the franchise that $50,000 worth of work shall be done the first year, that the fare from Redwood City to San Francisco shall be 20 cents, and that the cars are to be run every half hour. Considerable opposition to the franchise was developed, and a protest signed by 63 property owners of San Mateo was presented, but without avail. Contrary to reports previously circulated, the company has not as yet definitely determined upon the system to be used, other than that it is to be of overhead construction. The company is now building its track, and erecting poles and over head wiring with all possible speed in order to get the work done in the city limits before adverse action can be taken by the supervisors. The road is now completed from the ferries to the Mission outskirts of the city.

The contract for lighting the city of Oakland for the ensuing year has been let to the Oakland Gas Light & Heat company. For arc lamps for street illumination, to burn each and every night until 1 A M., the price realized was 40 cents, and for incandescent lamps for public buildings situated on the line of the company's wires the rate is to be $1.50 per month for each lamp of 16-candle power, to burn each and every night until midnight. A subsidy of $75,000 has been raised for the proposed electric road to be built between Haywards and Oakland.

The well known Black Diamond coal mine near Seattle, Wash., has been equipped with an electric power plant by the Electrical Engineering company of San Francisco. The plant consists of a 120 horse power constant current generator and an 80 horse power motor of the same type which is used to operate a coal hoisting machine. This is placed at the top of the slope 450 feet in length, and the distance of the hoist from the mine is 3 100 feet. On a test 12,000 pounds of coal were hoisted at one trip up the slope in one and one half minutes. The machines are both of the Keith type, and the generator, which is the largest ever manufactured on the Pacific coast, weighs 11,000 pounds.

The Oakland, San Leandro & Haywards Electric Railway company, which has been incorporated with a capital stock of $500,000, has been refused a franchise by the Oakland City Council, and concluded to make its terminus at the foot of Park street, Alameda. Continuing out Park street, the proposed road will pass through Fruitvale, a suburb of Oakland, thence along the San Leandro road, through the town of San Leandro and on to Haywards. The road will be over sixteen miles in length.

The statement recently published to the effect that the Union Electric Power company of Portland, Ore., had purchased five No. 16 Edison generators is correct in that the dynamos were No. 60 of 175 kilowatts each. This is the largest power plant on the Pacific coast. The power generated is to be used for the operation of the Transcontinental Street Railway company and the Multnomah Street Railway company, and is to be delivered to a point three miles from the generating station. The current will be carried this distance over the three wire system, one side of the system being used for supplying current for the street railroads, and the other side is designed to operate power circuits throughout the city.

Large forces of men are at work on Market street digging trenches and laying the terra cotta conduits for the new subways of the Pacific Telephone & Telegraph company. The conduits used are identical with those adopted in Chicago, and already they have been laid along Montgomery, Sansome and Battery streets, and most of the cross streets from Battery to Kearney, and from California to Market streets. The cables are being drawn in, and the subscribers within the subway districts will soon be working through underground circuits. In the meantime the old Mercantile Library building on Bush street, which was purchased by the Telephone company some months since, is undergoing extensive alterations. Two new stories are being added, making six in all, and the interior is being rearranged to suit the convenience of the company. About three thousand subscribers are handled over the switch-board now in use, and although it was erected only three years ago, and cost considerably over $50,000, yet it is now considered antiquated, and is soon to be replaced by a much larger board of the most approved type.

Hotel Pleasanton, which is the largest private hotel in San Francisco, is to be equipped throughout with an incandescent installation of over 1,000 lights. A few weeks ago the Pacific Electrical Storage company finished the installation of about 400 lights in the parlors, dining hall, etc., and so satisfactory were the results that the entire building will be lighted by the storage system, a contract for the work having been signed last week.

A test of the Thomson watt meter was made recently in order to satisfy a customer, who complained of exorbitant bills. It was decided to check the light consumption for forty-eight consecutive hours, and to do this two men were employed. Their instructions were to make note of the exact time to the second of every lamp which was burned or extinguished, and at the end of the forty-eight hours their report was found to tally with the watt meter so nearly as to be regarded as correct. In fact, the watt meter showed a difference of 30 cents in favor of the consumer, the total bill being considerably in excess of $30.

An Edison Electric drill placed in an Idaho mine bored a two inch hole through twenty feet of solid granite in four hours. The working of the drill excites a great deal of curiosity, as well as favorable comment among miners all over the coast.

From San Diego comes the report of a fishing expedition of alleged novelty, which left on June 4th, for a three or four months' tour. A small electric lighting plant had been placed on the sloop. Fishing is to be done by the aid of submarine incandescent lights and a net. Experiments that had been made in the Bay of San Diego proved that everything alive under the water was attracted by the glare of the light, and thousands of fish of every description were taken in a short time with very little trouble. The crew consisted of four men, and their first work will be done off the fishing banks near San Clemente Island.

Articles of incorporation of the Pasadena and Mt. Wilson Railway company have been filed. This is to be an electric railway twelve miles in length, and will reach the summit of Mt. Wilson in the Sierra Nevadas. On the summit of the mountain a hotel and observatory are to be erected. It will be attempted to have the road running before the summer season is over.

Wardner, Idaho, is to have an electric light plant as an Edison Illuminating company has been organized there, its directors being Chas. Swaany, P. C. Conroy, Alexander Monk, Alfred Page and Wm. T. McCaskey.

The trustees of the town of Berkeley, Cal., are considering the application of Carey T. Morgan and others for a franchise for a waterworks and electric light plant. S.

Pittsburg, Pa.

PITTSBURG, Pa., June 20.—Now it is the Birmingham Traction road which has started the operation of its electric street railway system. It is one of the oldest street car companies in this part of the country. It connects the city of Pittsburg proper with what was formerly known as the borough of Birmingham, a portion of the city situated on the southern bank of the Monongahela river. The lines of this company cross that river by the Smithfield street bridge, which forms the most direct communication between the city and the south side. The Birmingham Traction owns the only franchise over this bridge, and thus monopolizes the only means of street car travel to that part of the city.

The company decided upon the transformation of the motive power of its lines more than a year ago, but a number of obstacles were raised, which greatly retarded the work of completing the installation of the system. The company was compelled to erect an addition to the Smithfield street bridge in order to be able to traverse that structure with the electric cars. This alone took over six months. The company also built a very handsome power house as well as new car stables.

It appears, however, that all the difficulties are overcome and the trial trip of the cars, which was made last night, was very successful.

The power house is equipped with two 500 horse power engines and four dynamos of 200 horse power each. The switch-board is particularly handsome, it being made of polished slate. The company will operate thirty cars, which were furnished by the Gilbert Manufacturing company of Troy, N. Y. The electrical equipment of the cars is of the Edison and Short type.

W. C. Cheney, the superintendent of the Willamette Falls Electric company of Portland, Ore., has been in this city for over a week. Mr. Cheney has come on East in the interest of his company. He was one of the first electrical engineers out West who realized the great advantages which might be derived from the utilization of water power, and it has been mainly due to his untiring efforts in this field that the company was started in Portland for the purpose of making use of the immense power of the Willamette Falls.

E. H. H.

Portland, Ore.

PORTLAND, Ore., June 18.—The city of East Portland has closed with the Edison General Electric company for a 100 2,000-candle power arc light plant to be installed at once. The steam contract was let to Staver & Walker, and is to consist of two Reynolds Corliss engines.

The Union Power company is very busy erecting the new building. Owing to the locality it was necessary to do considerable piling for foundations.

The Edison General Electric company reports a brisk business in Idaho. Work on Boise City Electric road has begun in earnest, and will be completed at an early date.

The Northwest Thomson-Houston company has recently moved into new and commodious quarters located on the corner of Front and Vine streets. Three floors and basement furnish room for their increasing business.

The North Pacific Industrial association has contracted with the Northwest Thomson Houston Electric company for 100 2,000-candle power lights to illuminate the building during the coming exposition.

The Willamette Falls Electric company is installing a 100 light arc dynamo of the Excelsior type. N. W.

Nashville, Tenn.

NASHVILLE, June 20.—The Nashville Electric Railway and Power company has its line now in full operation, and its cars, starting from the corner of Cherry and Cedar streets, run to the extreme northern limits of the city. The company has opened a fine waiting room on Cedar street and provided an attendant to take care of parcels, umbrellas, etc. The Citizens' Rapid Transit company's cars run westward beyond the city limits to Cherokee Park, in the village of West Nashville, while the cars of the various lines of the United Electric company passing this corner run north, west and south to all points of this city on the west side of the river. For ten nights recently, during a spectacular exhibition, the companies were able to concentrate enough cars on one line, all taking current from the same wire, to move a crowd averaging from three to five thousand, within thirty minutes after the close of the performances, and not a single accident occurred.

The Maplewood extension of the Fatherland street line has been completed and put in operation. Work on the Belmont and Grand avenues and Hillboro turnpike extension has been begun and is to be completed in ninety days. This extension is a part of the United electric system. The Citizens' Rapid Transit has secured franchises for considerable extensions.

The project for converting the West Nashville steam dummy line into an electric road has been abandoned and that company is now asking for the privilege of transporting freight with a view to selling out its line to the Illinois Central or the Midland railroad.

Last week the Thomson-Houston company and the Nashville Light and Power company closed a deal by which the former purchased $60,000 worth of stocks and $50,000 of bonds in the Capitol Electric Light company. This purchase practically gives the Thomson-Houston company control of the electric lighting system of this city. The franchise was originally held by the Light and Power company, which sold out to the Capitol Electric company, and the present transfer puts an end to many complications. The gas company, city council, Board of Public Works, the newspapers and the public are all at loggerheads about renewing the gas contract, which expires

in October; and the present appears to offer a fine opportunity for the extension of the electric light system.

The suit of the Edgefield Bank of South Carolina against the Nashville Electric Light and Power company in the United States Circuit court, which promised to be a serious one, and of which mention has been made in the WESTERN ELECTRICIAN, has been dismissed, a compromise having been effected.

There is an alleged shortage of about $11,000 in the accounts of the treasurer of the Cumberland Telephone company, and a committee has been investigating the matter for several days. The treasurer was a woman of most estimable character and high standing, who, since the accusation was made, has been utterly prostrated, part of the time unconscious. It is generally believed that the short age, if there is any, was due to mistakes in bookkeeping, caused by overwork

The managers of the Western Union, Postal Telegraph and Electric Time companies were all arrested a few days ago for doing business without a license, their respective companies not having accepted the right of way and conditions granted by the city within the prescribed time. They all gave bonds and were allowed ten days in which to settle. B.

Denver, Colo.

DENVER, Colo, June 20.—The Arapahoe Electric company is in the field for municipal lighting. Articles of incorporation have been filed with the secretary of state creating the company with a capital stock of $500,000. The incorporators are E. W. Lowry, W. F. Henderson and J. F. Regan of Denver; E J. Riley of Omaha; C. L. Penfield and J. D. McDonald of Fremont, Neb., the four last named being practical electricians. The intention is to make a bid for city lighting, and as soon as a franchise is secured operations will be pushed rapidly. Mr. Lowry says there is plenty of money behind the enterprise.

The Denver Tramway directors have decided to extend the University park line a mile and a half beyond the present terminus.

A big transit deal said to have been consummated is the purchase by the Denver Tramway company of the suburban road and right of way, which will be an important addition to the Tramway's system of cable and electric lines. It is believed the consideration will not be short of $100,000.

A company of New York capitalists has entered into an agreement with Dr. John Law and Col. R. E. Goodell of Leadville, to put in an electric railroad from that city to Evergreen Lakes, the distance being about seven miles. The power for generating the electricity will be water, to be conveyed through about eight miles of flumes and ditches. The plant will be erected at Malta, and will be the largest in the state. The contract for construction of the road has been let to W. N. Marvin of New York. The work, which it is estimated will cost $450,000, will begin at once.

A new electric fire alarm system is being put in at Aspen under the direction of P. M. Johnson.

E. C. D.

Detroit, Mich.

DETROIT, Mich., June 22.—The consolidation of the Brush and Thomson-Houston interests in this city has been effected. The present organization of the Brush company will continue, and business will be done at the old stand; but it will virtually be part of the Thomson-Houston combination. The Brush company will be guaranteed a certain percentage of the earnings. The Detroit Electric Light & Power company is a member of the combination, as the Thomson-Houston people own a majority of its stock. This company at present has the contract for lighting the city, and the new agreement frees it from the litigation begun by the Brush company over the tower patents in use.

Secretary H. L. Wilton of the Brush company denies that the combination will raise prices for electric lighting in Detroit. On the contrary, he says, the Brush company will spend $100,000 at once for new engines, displacing the engines which they put in ten years ago, and enabling the company to give better service. Yet, he says, the excessive competition in this city had reduced prices lower than in any other place, and that if it had continued, one or the other company would have been crowded out, and a half million or more cash invested would have been lost.

Application has been made to the common council of Hastings to build a $13 000 electric light plant, and light the city.

The strike of the car drivers in this city has been watched with interest throughout the country. During the last two weeks the men have held out and prevented the company from running the cars. It was finally agreed to arbitrate, and when the men submitted their statement most of the demands were immediately granted without arbitration.

The total length of street car lines in and near this city is at present 78 miles, not counting side or double tracks. Of these the City railway has 56 miles; the Grand River, 12; and the Fort Wayne and Elmwood, 10; employing altogether about 750 men and 2,350 horses. The two electric trolley systems on the north and east sides, almost exclusively suburban, have 10½ miles of track.

Taylor, Woolfender & Co. of this city have lately equipped their store with the Martin cash system, the only one in operation west of Buffalo. It is run by a two horse power electric motor, operating an endless cable at the rate of twenty feet per second, and carrying cash boxes from every floor to the cashier's desk. A box makes the round trip of the store in forty-seven seconds. G.

PERSONAL.

Morris Mead, superintendent of the Bureau of Electricity of Pittsburg, Pa., has been elected president of the newly formed electric club of that city.

Capt. Willard L. Candee of the International Okonite company (limited), New York, starts for Europe July 1st, on the White Star steamer Teutonic.

Prof. F. B. Crocker of Columbia College, New York, was in Chicago last week. Prof. Crocker was enthusiastic in his view of the outlook for the electrical engineering department of Columbia. His first class was graduated at the commencement exercises two weeks ago.

NEW INCORPORATIONS.

Stoughton Electric Light & Power company, Stoughton, Wis.; capital stock, $10,000; electric lighting.

Edison Illuminating company, Wardner, Idaho; capital stock, $30,000; operating electric plants.

Charleston Thomson-Houston Electric company, Charleston, Ill.; capital stock, $40,000; to furnish electric light and power.

Moravia Electric Light, Heat & Power company, Moravia, N. Y.; capital stock, $20,000; manufacturing and producing electricity for light, heat and power.

Salina Light & Power company, Salina, Kan.; capital stock, $100,000; to furnish electric light and gas for lighting, heating and mauufacturing purposes, etc.

Bellevue Light & Power company Bellevue, O.; capital stock, $20,000; to purchase and furnish electric and gas light; to sell coke; to erect electric light plants, etc.

Fairview Land & Improvement company, Norfolk, Va.; capital stock, $50,000; real estate and improvements, building and manufactures, water, gas and electric works.

Lincoln Water, Light & Power company, Lincoln, Ill.; capital stock, $250,000; to maintain waterworks, electric lighting and build and maintain an electric street railway.

Peninsular Electric Light company, Detroit, Mich; capital stock, $600 000; to supply electric light and purchase the right and privileges of the Brush Electric Light company.

United States Electric company, Chicago, Ill.; capital, stock $10,000,000; to manufacture, vend, lease and deal in electrical inventions, machines, instruments and appliances.

Sayre Electric Light, Heat & Power company, Sayre, Bradford county, Pa.; capital stock, $5,000; supplying light, heat and power by means of electricity to the public at the borough of Sayre.

Carbondale Electric company, Carbondale, Ill.; capital stock, $5,000; to erect and operate an electric plant and furnish electricity for light, heat and power, and furnish steam for heat and power.

Cotton Shoals Electric Light & Power company, Granitesville, S. C.; capital stock, $10,000; to construct, own and operate electric power plants, to provide, sell, rent, or lease electric light, power, etc.

Cedar Rapids & Marion City Railway company, Cedar Rapids, Ia.; capital stock, $400,000; building, operating, leasing electric railways on streets and highways, especially in Marion and Cedar Rapids, Ia.

Santa Ana Gas & Electric company, Santa Ana, Cal.; capital stock, $100,000; to manufacture illuminating and heating gas, including electricity in any form, and to build and operate gas motors and electric motors.

Quincy Electric Freight Railway company, Quincy, Mass.; capital stock, $300,000; locating, constructing and operating a railway with electric motive power for the transportation of freight in the city of Quincy and vicinity.

Minneapolis Electric Light & Power company, Minneapolis, Minn.; capital stock, $750,000; generation, storage, transmission, application and use of electricity for lighting, heating, motive and other purposes, manufacturing, buying, selling and otherwise disposing of and dealing in all kinds of materials, conductors, conduits, machines and mechanical contrivances used in the generation of electricity.

Universal Electric Railway Construction company, Camden, N. J.; capital, stock $500,000; to manufacture, use and sell mechanical and electrical machines, devices and contrivances, for regulating and furnishing light, heat and power.

Portland, Nehalem & Astoria Railway company, Portland, Ore.; capital stock, $1,000,000; construct, equip and operate railroads, electric, cable and telegraph lines from the city of Portland, Multnomah county, to the city of Astoria in Clatsop county, Ore.

Johnstone Underground Conduit Construction company, New York, N. Y.; capital stock, $1,250,000; purchasing, owning, selling, renting or operating a system of underground conduits for electrical or other conduits and also constructing such conduits, etc.

ELECTRIC LIGHTING.

Halletsville, Tex., will soon have electric lights, having purchased a complete plant of the Heisler Electric Light company of Philadelphia.

Electric light plants have been or are about to be installed in the Spanish towns of Jaen, Aranjirez and Avila. None of these places had been lighted by gas.

So great has been the demand for electric lights of the company recently organized in Copenhagen, Denmark, that the original plans have been once or twice enlarged.

It is said that 10,400 electric lights will be used to light the new public buildings, Broad street square, Philadelphia. Over 30 miles of copper wire will be necessary and 10 miles of conduit tubing has been laid.

In a paper read at Zurich Prof. G. Lunze, one of the party of European engineers that visited the United States last fall, in speaking of electric street lighting, says that Chicago is the best lighted of American cities.

During the ensuing fiscal year the electric lighting plant of Chicago will be increased by about 400 arc lamps. Of these about fifty will be located on the South Side, nearly all the remainder being placed on the West Side.

The corporation of Sheffield, England, recently decided to light some portions of the town by electricity, but the work has been delayed by the board of trade, which insists on underground wires, although it had formerly sanctioned overhead work.

On account of the excessive gas rates in Madrid and the high price of imported lamps, it is said that there is an excellent opening for an establishment to manufacture incandescent lamps in the Spanish capital. It is asserted that an output of 2,000 lamps a day could find a profitable market.

There is at present but one electric light company in Denver, Colo., and there is talk of the organization of a competing company. The old company receives $14 50 per month from the city for each arc lamp used for street lighting. This is at the rate of $174 a year for each 2,000-candle power arc lamp. For incandescent lamps for street lighting in the residence sections of the city $26 a year is charged for each 20 candle power lamp.

A unique electric light plant is to be established at Yreka, Cal. The *Pacific Fireman and Public Works Record* reports that James Quinn has commenced making preparations to establish his electric light plant to supply Yreka with electric lights, by placing a water wheel in Shasta river at the canyon below the mouth of Yreka creek, where he obtains a 24 foot fall by building a ditch a few hundred yards long. A small ditch at his water location is to be enlarged so that it will be 12 feet wide and 3 feet deep, and will carry between 5,000 and 6,000 miners' inches of water, capable of producing from 60 to 100 horse power. In about three months from now Yreka will be lighted by electricity.

An English firm has established a factory for the production of incandescent lamps in the village of St. Nicholas, near Dieppe, France. Albert Hoster of London is the leading spirit in the enterprise, and it is said that the works cover about an acre of ground. It is believed that this factory is the first of its kind in France upon a commercial basis, and the assertion is made that the stock of lamps is the largest under one roof in the world. Mr. Hoster has introduced a staff of English-trained working electricians, and placed them under a thoroughly experienced French manager as foreman in the various departments. The French work people also employed are working in perfect harmony with them.

English papers report that, by the aid of the electric light the botanical mission dispatched some months since by the authorities of Kew to the West Indies, was extricated from an embarrassing dilemma. The members of the expedition had with them a number of Wardian cases containing vine cutting, and Gambier plants, which it was deemed very desirable to introduce into the islands; but unfortunately, cold whether set in, and the efforts to convey these tender plants, which had so often ended in failure, threatened once more to result in disappointment. The difficulty was that if kept on deck they would be inevitably destroyed by the low temperature, while if taken below the absence of light, which is so necessary to the existence of the delicate Gambier plants, was almost certain to be equally fatal. Under these circumstances it occurred to Mr. Morris to avail himself of the electric light, of which there was an abundance aboard the Atrato. The experiment proved successful.

ELECTRIC RAILWAYS.

It is expected that the Asheville, N. C., and Sulphur Springs electric line will begin operation soon after July 1st.

The electric railway system of Rochester, N. Y., is to be extended, by means of the Park avenue line, to the suburb of Brighton.

The Cicero & Proviso Electric Railway company, Chicago, is erecting a two story brick and stone building on Madison street, near Fortieth, to be used for car shops and waiting rooms.

The new electric railway running from Asheville to Rutherfordton, N. C., will be 41 miles long, and probably the longest in the country. Both passenger and freight cars will be operated.

An overhead trolley line two and one half miles long is to be constructed in the suburbs of Leeds, England, by the Thomson-Houston company It is claimed that this will be the first overhead trolley road in England.

The Texas supreme court has decided that a motor man on an electric street car may act upon the presumption that teams not upon or approaching the track, but standing on the side of the street, are hitched, or, if not hitched, are not liable to become frightened and run away.

Baltimore is in the throes of an overhead trolley controversy such as so many cities have gone through. The Baltimore City Passenger Railway company wants to operate its lines by electricity, but usual number of "the-present-way-is-good-enough-for us" objectors are to be found.

About July 1st Paris will have an electric railroad. The route will be from the Rue Lafayette, near the Opera, to St. Denis, over a line having some very steep gradients. The rolling stock is to consist of twenty cars, which are being constructed by George Averly of Lyons, after an American model. They will carry fifty-four passengers, and attain a speed of ten miles an hour.

In Augusta, Ga., recently, where the electric cars had been operating at 12 miles an hour, the council, for some reason, passed an ordinance restricting the rate to 5 miles, retrogading the service to the days of mule power. But the people, who had not desired any such restriction, were so outspoken and emphatic in their indignation that the objectionable order was speedily annulled.

A dispatch from Ansonia, Conn., says: "John Kelley, an employe of the Ansonia & Birmingham Electric Street Railway company, was repairing an overhead wire in the yard of the company. June 2d He had both hands on the wire, and his head came in contact with the iron sheathing of the car shed. Five hundred volts went through his body. He stiffened out and began frothing at the mouth, when Foreman Kennedy pulled him away, and he was lowered to the ground. In five minutes he sat up and asked of the crowd about him what was the matter. Kelley's ear is burned a little where it touched the iron sheathing, and his hands have black marks on them. Otherwise he is all right."

Gong signals designating the destination of electric cars are suggested by the correspondent of a Rochester, N. Y., paper. This innovator claims that in the evening it is very difficult for some people to distinuguish the various colored lights which indicate the different lines; and, where so many lines use a common starting point down town, he frequently finds himself on the wrong car. To obviate all this, he suggests a code something like this: On one line the drivers should sound their gong with two even blows, thus: — —; and another, one long and two short blows, — — —; another, two short and one long — — —; or, in other words, practically adopt so much of the Morse telegraphic alphabet as may be necessary to provide each line with its particular gong signal.

Texas cities appear to be pre-eminent in the amount of electrical railway mileage they possess in proportion to their size. Recently the claim of Galveston, that it had more miles of electric street railway in proportion to its population than any other city in the country of over 20,000 inhabitants, was published. Now it is asserted that San Antonio is entitled to that honor. The figures in the case of Galveston are forty miles and 35,000 inhabitants, or a mile to every 875 of the population. San Antonio, it is claimed, with a population of 40 000, has fifty-six miles of electric railways, and about ten more projected. This gives a mile to 714 people. Adding the ten miles in prospect the proportion is lowered to 606. It would be interesting to hear from other cities in this respect.

The Edison General Electric company has sued M. H. Sherman and T. V. McDonald of Los Angeles, Cal., for $37,000. From the complaint it appears that in February, 1890, the Sprague company agreed to equip an overhead electric railway system for the Electric Rapid Transit company of Los Angeles, for $55,000. Materials for the road were furnished, but the transit company refused to carry out its portion of the agreement. A suit for damages was brought, but was subsequently dismissed at the instance of Sherman, who offered to pay $40,000 to have the road constructed. A contract to this effect was drawn up and signed, the defendant McDonald giving a written guaranty that Sherman would carry out its provisions to the letter. The latter has not done so, however, and hence the present suit.

Citing the case of the interurban electric road between St. Paul and Minneapolis, which has practically supplanted the steam service, the *Railway Review* remarks that "electricity is demonstrating its ability, when properly managed, of cutting into the business of existing steam railroads." After enumerating the superior advantages of the electric railway in the case in question, the *Review* concludes "Similar conditions of travel in other places will doubtless be met in the same way, and before railroad men realize it, electric railways will be running, the character of whose traffic will bear a very strong resemblance to that of steam railways. In this growth the fact may be developed that a comparison between steam and electricity will not always lead to the results obtained in the experiments thus far made."

Work on the new North and Guilford avenue electric line in Baltimore has begun. The order for the poles and wire was given about two weeks ago This part of the work and the track-laying were awarded to David E. Evans of Baltimore. The rest of the work on the line and the supplying of cars and motors will be done by the Baxter Motor company, also of Baltimore. The delay in pushing this work is said to have been due to a desire on the part of the directors of the North avenue company to effect some agreement with President Perin of the Union line for a joint use of tracks on North avenue. All negotiations to this end have so far failed, and the projectors of the North avenue company say that it looks as if they will be forced to adopt the provision in their ordinance giving them the right to lay inside and outside rails.

Arthur Luetchford of Rochester, N. Y , who has taken a prominent part in electric railways and other electrical enterprises of late, has tendered his resignation as director, secretary and treasurer and member of the executive committee of the Rochester Railway company, and also the presidency of the Rochester Electric Railroad company his directorship in the Bell Telephone company of Buffalo, the Rochester and Lake Ontario Railway company, the Buffalo railway, the Rochester Turnpike company, the Grand View Beach Railway company and other corporations with which he has been connected. These resignations will take effect July 1st. Mr. Leutchford's only object in taking this course was to secure relief from the responsibilities of the positions. His interests in the companies remain the same. He is still a young man and it is to be hoped that he will fully regain his health.

ELECTRIC MOTOR.

It is reported that quite an active demand for electrically propelled boats has sprung up in England, a number of orders for this sort of craft having recently been placed with manufacturers.

A pleasure boat to be made of aluminum, and to be propelled by electricity developed from a storage battery, also made of aluminum instead of lead, is being designed in Pittsburg, Pa., according to a dispatch from that city. D. J. Cable is the designer. The boat will have a screw propellor. The inventor says that a boat designed to carry four or six persons will not weigh more than from sixty to seventy pounds.

The new electrically propelled yacht, the Electron, recently made a successful trip on the Hudson. The vessel is a screw propeller, 75 feet long, with an iron hull. The power plant consists of 376 accumulator cells and a 15 horse power motor. The switches governing the current are placed in the pilot-house, so that the captain or pilot has complete control of the vessel. The yacht will run ten or twelve hours on one charge of the accumulators. The trial trip was thoroughly satisfactory. With a larger propeller it is thought that a speed of 12 or 13 miles an hour can be made.

The proposal to utilize the river Yarra, at Warrandyte, near Melbourne, Australia, for driving machinery by electric power has at last taken definite form. At a meeting of the executive council held recently a water license was issued to Alcock & Co., electrical engineers, for a term of fifteen years. The company is to have the right to divert not more than four-fifths of the Yarra at Warrandyte through a tunnel, which was constructed some years ago by a party of miners. It is intended to utilize the water in driving turbine wheels, which will in turn supply power for electric generators. The *Australasian Manufacturer* says that a company will shortly be floated in London to carry out the work.

It is said that no fewer than twelve towns in Switzerland are furnished with electric light and power plants operated by water power from Alpine torrents. A co-operative company has lately been formed at the village of Faide, on the Gothard railway, a place numbering 1,000 inhabitants. By means of an iron pipe a small supply of water is obtained from the neighbouring Pinmogna torrent, which drives a small high-pressure turbine, which in turn operates a dynamo supplying 360 incandescent lamps. The whole cost less than $10,000, which sum is divided into shares of $75. In this manner, in addition to the streets and railway station, the peasants and working men have their houses supplied very cheaply with the electric light.

ELECTRIC WELDING.

The only change made in the directory of the European Electric Welding company at its annual meeting held in Portland, Me., recently, was the election of George P. Messervy of the banking house of Putnam, Messervy & Co. in place of Charlton T. Lewis of New York. The report of the treasurer submitted at the meeting, showed that the company had a balance of $320,000 on hand.

The big welding plant at the works of the Johnson company, Johnstown, Pa., is being enlarged. A year ago last April one machine was installed, which was a combination bar splicer and used for joining rails on switches and crossings. Last fall two more machines were put in, one of which was for large welds of four-inch sections on various articles; the other machine was for welding rails in crossing at various angles. This latter machine will make a weld eight inches in section Of the two machines being installed, one will make a weld eight inches in diameter, while the other will make a weld four inches. The company will put up a power house and equip it with five 100 horse power and two 150 horse power Ball engines. A special boiler house will be erected. All the electrical apparatus used will be of the Thomson type.

TELEPHONE.

There are 1,800 telephone subscribers at Leipsic, Germany.

The telephone system of Sweden is being rapidly extended.

At the recent meeting of the Bell Telephone company of Holland a dividend of 8½ per cent. was declared.

A scheme is on foot for the connection of the principal towns in Yorkshire, England, by telephone. Metallic circuits will be used.

The Idaho Telegraph and Telephone company will construct a telephone line between Rathdrum and Mica, in Idaho, a distance of fifteen miles. The principal office will be at Post Falls.

A new telephone company, known as the Chicago Mutual Telephone company, has been organized in Chicago, with a capital of $1,000,000. The principal mover in the enterprise is F. R Meadowcroft, but he told a reporter that he was not yet prepared to talk about the matter for publication.

Complaint is made that in several recent instances persons who have used the Paris-London telephone cable have received severe shocks. On one occasion a gentleman who had just placed the receiver to his ear in the Paris office received a shock of sufficient strength to throw him to the floor. The officials attribute these casualties to lightning striking the wire either at San Gatte, where the submarine cable ends or at the terminus of the land wire on the Place de la Bourse. Such accidents, it is thought, can easily be prevented by the simple expedient of erecting lightning conductors at the point where the cable comes ashore and at the terminus in Paris.

In the course of an article on "Railway Building in Hawaii," by Alenui Hau, in the May number of *Engineering*, occurs this interesting passage: "The telephone is probably more universally adopted in Honolulu than in any city of the United States, size for size. There are two rival companies who have cut rates until soda water stands are able to put in the instruments. All the marketing is done and all the daily scandal is talked through the telephone. Locomotion of the body produces high commotion of the blood, and under the influence of these electrical conveniences people use their legs as little as possible. The street cars and steam railroads are all started and organized by telephone, and an electric railway is already the topic of the hour."

TELEGRAPH.

A telegraph station has been opened at Fort Tuli, in South Africa, 600 miles north of Kimberley.

The Connellsville Coal & Coke company of Tacoma, Wash., will erect telegraph and telephone lines.

On the night of the Corbett-Jackson prize fight in San Francisco the *New York Herald* was enabled to "scoop" all its New York contemporaries by a feat in fast telegraphy. The story of the fight was sent over the Postal company's wires and relayed from Winnipeg direct to the *Herald* office. It was started at 12.10 a. m., New York time, and finished at 3 15. More than 4,500 words were transmitted by Mr. Edwardie, at Winnipeg, and received by W. C. Cherry over a circuit 1,800 miles in length.

During a recent storm in Devon and Cornwall, in England, the Porthcurno station of the Eastern Telegraph company found its land line communications with the rest of the island interrupted extending over half those counties. The cables, however, remained intact, and by their aid frequent and rapid communication was held with the company's Londonstation by way of Lisbon, Gibraltar, Malta, and Marseilles, a distance of over 9,000 miles, urgent service messages being frequently exchanged within the space of a few minutes. In one working day of 23 hours and 24 minutes no fewer than 1,558 messages were exchanged between London and Marseilles, being an average of 67 messages per hour, many of them very long, and the majority composed of difficult code words, or cipher. This was accomplished by hand working only, over a wire nearly 9,000 miles in length composed of aerial, submarine and subterranean sections.

MISCELLANEOUS.

There will be an electrical department in the coming Tasmanian exhibition.

The harbor authorities of Southampton, England, have decided to adopt electrical cranes for the unloading of vessels, on account of the greater rapidity with which the work can be performed.

Many statements have of late been circulated to the effect that the carbon manufacturers had combined or formed a trust. This has been authoritatively denied by the representatives of the leading concerns. It is claimed that smaller companies have been circulating the reports with the idea of securing business.

It is stated that the Westinghouse Electric & Manufacturing company's profits for the first half of the current year, or until June 30, will be about $200,000 under the reorganization, Mr. Westinghouse, however, is confident that the company can earn $1,000,000 net per annum. Nearly 90,000 shares of stock have assented to the plan of reorganization, and enough is assured to bring the aggregate up to 110,000 shares.

Severe electrical storms were experienced last week in Ohio and Pennsylvania. At Alliance, O., Alfred Barnhart, while plowing, was struck by lightning and killed; in

Butler county, Pennsylvania, a boy named Robert Taylor was killed; near Emlenton, Pa., young Clarence Ashbaugh was struck and killed, and several derricks throughout the oil country were struck and burned.

It now appears that the originality of Edison's embryo invention, the "kinetograph," recently alluded to in this paper, is controverted by a Mr. Rudge, of Bath, England, who, according to the London *Electrical Engineer*, "has prior claims which will hardly be disputed. Mr. Rudge has quite recently perfected an electrical arrangement which greatly assists in giving a faithful reproduction upon a screen of what we may term continuity of action. By means also of an optical arrangement not generally known. Mr. Rudge is able to project upon the screen a series of pictures in which the action seems continuous from one point to another. The eyelids seem to move, or the lips, or the arms, or whatever part of the body is in motion."

An electrical engineering exhibition is to be held at Taunton, England, during the months of August, September and October, on the grounds adjoining the Taunton Electric Lighting company's central station. The exhibition will comprise the following departments: (1) Lighting by electricity; (2) heating by electricity; (3) machines, etc., for producing electrical currents by mechanical power; (4) electric motors and their applications; (5) electric welding and brazing; (6) electric batteries—primary and secondary; (7) apparatus for electrical measurements; (8) the phonograph; (9) the telephone; (10) electric telegraphs and electric signals; (11) electricity in surgery; (12) electroplating; (13) application of electricity in various ways not specified above; (14) steam engines, pumps, etc.; (15) gas and oil engines; (16) models of all descriptions. Applications for space should be sent to the secretary of the exhibition, Harry C. Wilson, Bath Electric Light Works, Bath, England.

Lightning played a queer prank in Bridgeport, Conn., recently, according to a press dispatch. The current struck the residence of John H Orton, who resides on Park avenue. As the bolt struck the house it followed the rod across the roof and down to the ground. It then struck the drain-pipe, passing underneath the street to about the center, when it capped the climax by bursting the water-main pipe on Shelton street. Suddenly the water began to boil, and the next instant a stream of water three feet in diameter and forty feet high shot up into the air. The news of the break soon spread about the neighborhood, and despite the terrible storm a large crowd soon collected. The sight was a splendid one, and lasted for over an hour. The streets were flooded with water, and the sewers were unable to carry off the surplus. The cellars in the neighborhood were all filled. Two women had a narrow escape from being killed by the lightning, which broke the pipe. One of them was knocked down and severely shocked.

TRADE NEWS.

The Electrical Supply company of Chicago has made the address "171 Randolph street" familiar to every one in the country directly or remotely interested in things electrical. But it is going to leave it. The company has been in the throes of "moving" for several weeks, and is still engaged in getting its large stock transferred to the fine, double, five-story building, corner of Randolph street and Michigan avenue, known as 102 and 104 Michigan avenue. That the supply company will emblazon its new address on the minds of the fraternity, as it did the old, goes without saying.

Electric coal cutters are being rapidly introduced in many mines, replacing hand labor. With them it is possible to effect a larger saving of coal than is possible by hand labor, due to the small height of the undercut. The number of men which have to be employed can also be materially reduced. The Edison General Electric company is putting a very effective electric coal cutter on the market, either of the rotary or reciprocating type. It is operated by a 15 horse power motor, and is capable of making a cut, either four, five or six feet deep, according to the size of the machine, by three and one-half feet wide. The merits of the apparatus are set forth in a comprehensive little pamphlet just issued by the Edison company.

Large ventilating exhaust fans, with C. & C. motors connected directly to the fan shafts, have been running for several months in the Pennsylvania State Capitol building at Harrisburg, one in the assembly and one in the state chamber. The members have been most enthusiastic over the success of the machines, and have passed resolutions testifying to the great improvement the outfits have effected in the atmosphere of the room. The White Star steamship, "City of New York," has been equipped with C. & C. fan outfits with 18 inch fans. The Edison Electric Illuminating company of New York bought one hundred C. & C. fan outfits last week. The new operating room in the City Hospital, Rochester, N. Y., is ventilated by a C. & C. exhaust electric fan combination with a 36-inch fan.

Slate one inch thick weighs fourteen pounds per square foot, and when it is of the select quality is easy to drill and tap, so that machine screws can be used. Recently a New York construction company drilled 12,000 one-quarter inch holes in a piece of slate containing twenty-two square feet five-eighths of an inch thick. It withstood shop handling and transportation, which, taking into consideration the fact that the holes were only one-fourth of an inch apart, speaks well for the strength of the slate. The best slate for electrical purposes is claimed to be that found in Vermont, where, probably owing to the absence of iron ore and other metals, the mineral is much purer than that quarried elsewhere. Soft slate has a slight greenish color, although it is frequently found in "purple stock" and other colors. The Boston office of the American Bell Telephone company has recently been equipped with a slate switch-board, built by the Western Electric company. A number of other slate switch-boards have recently been put in in New York and Brooklyn. T. J. Murphy, 96 Columbia avenue, New York, and Fair Haven, Vermont, deals in slate for electrical purposes, and is supplying large quantities to manufacturers of electrical apparatus.

BUSINESS.

The extent to which a business can be energetically and profitably advertised is exemplified by the Electrical Supply company, 171 Randolph street, Chicago. One item of expense with it is the distribution of literature concerning specialties which it either manufactures or is intimately interested in. The company's postage bill alone amounts to over $5,000 a year.

The extensive new works of the Walker Manufacturing company at Cleveland were formally opened on June 13th with speeches, presentations to the officers of the company and dancing by the employes on the waxed floor of the big machine shops. This company has one of the largest machine shops in the country and will soon employ 1,500 hands. It manufactures street railway equipment largely.

The Page Belting company has supplied belts to the following business houses during the past month: Quincy Market Coal Storage company, Boston; Manufacturing Investment company, Madison, Me.; Milton Electric Light company, Milton, Mass.; Concord Street Railway company, Concord, N. H; E. W. Littlefield, East Boston, Mass.; Santley Lumber company, Wilmington, O.

Protzman's new arc light shifting device consists of a small windlass attached to the pole at convenient height. It has two small drums, with a shifter in the middle. Wire ropes are connected from this to the arc light through pulleys on opposite poles and above. By shifting these drums the lamp can be removed from the base of one pole to the other, simply by winding. It is claimed that by this simple mechanism a lamp can be lowered to the ground without climbing. J. R. Protzman of Streator, Ill, is placing the device on the market.

During the past week E. M. Izard of the Electrical Engineering company has been in California, sending in a fine order from San Francisco, while Mr. Pierce has been in Minnesota, and Mr. Seymour in Massachusetts, leaving Mr. Richardson to do the honors of the office. This enterprising company has just secured the contract for wiring the "Fair" building, which it is supposed will be the largest commercial building in the world when completed. This company reports a good demand for the Elektron apparatus. This company recently supplied a generator to the laboratory of the Rose Polytechnic Institute at Terre Haute, Ind., and one of 120 amperes to the Chicago Battery & Traction company, to be used at the office of this company in the Rookery for charging storage batteries.

A large standard photometer, designed for the measurement of incandescent lamps, has recently been made by Queen & Co., Philadelphia, for the Standard Lamp company, Appleton, Wis. This photometer differs from the large ones previously made in that it has special attachments for holding and testing the lamps, which enable the work to be done rapidly as well as accurately. The instrument may be briefly described as follows: The tables, about four feet high, support the standard bar, which is made of brass 500 centimeters long and graduated in 1,000 equal parts. The left hand table carries a sensitive candle balance arranged for weighing the candle while in use. A standard Methvin burner is furnished in addition, which gives a uniform gas flame, which has been found much more reliable than the candle flame. On the right hand table is a special lamp holder, which can be rotated so as to present any part of the lamp to the sight box. This holder is extremely convenient as it is only necessary to insert the lamp in the socket when a test is made, all connections being from below. A sight box on wheels moves along the bar, and curtains are provided to shut out all light except from the standard and the lamp under test.

ELECTRICAL PATENTS.

Issued June 16, 1891.

454,018. Electric Signal for Mine Shafts. Frederick W. Bacorn, Marysville, Mont.

454,020. Electric Railway Car. Edward M. Bentley, New York, N. Y.

454,021. Electric Motor Car. Edward M. Bentley, New York, N. Y.

The invention consists in a combined open and closed car, and a motor for propelling the same supported upon the axle and located so as to be accessible from above the floor of the car.

454,022. Conduit for Electric Railways. Edward M. Bentley, New York, N. Y.

In this device one of the slot-rails of the conduit is of such a form that it may be used at the same time as one of the track rails upon which the car runs.

454,023. Electric Railway. Francis O. Blackwell, Boston, Mass.

The last claim reads:

"13. The combination, in an electric railway, of a pivoted contact plow, with a spring clip in the motor circuit, comprising one terminal in circuit with the motor and a second terminal electrically connected to the contact maker and moving with the plow."

454,024. Electric Motor. Harry H. Blades, Detroit, Mich.

454,031. Electric Switch. Horace T. Clark, Bridgeport, Conn.

454,038. Incandescent Electric Lamp Controller. John J. Fanning, Chicago, Ill.

454,057. Galvanic Battery. William McMillan, New York, N. Y.

We quote claim one:

"A porous cell for galvanic batteries, consisting of a perforated cup of a stiff, fluid resisting paper."

454,060. Insulated Electric Conductor. Edwin D. McCracken, Alpine, N. J.

454,087. Electric Locked Switch. Francis Teague, London, County of Middlesex, England.

454,090. Transformer. Elihu Thomson, Swampscot, Mass.

Claim three reads:

"The combination of a sectional core and primary and secondary coils wound thereon, with the exterior closed frames of magnetic material notched or recessed in their outer edges, and bolts seated therein, binding the frames together."

454,091. Secondary Battery. Donato Tommasi, Paris, and Charles Theryc, Marseilles, France.

Claim one follows:

"In an electric battery, an electrode made in tubular form and provided at one of its ends with an insulating plate or disk and a suspending and conducting rod secured at one end to said plate."

454,095 Controlling Mechanism for Elevators. W. O. Wakefield, Lynn, Mass.

454,138. Bi-telephone. Ernest J. P. Mercadier, Paris, France.

454,155 Subway for Electric Wires. William Readman, Toronto, Canada.

454,156. Mast Arm for Electric Lamps. Thomas Dillon, Indianapolis, Ind.

454,177. Conduit for Underground or Subway Electric Systems. John J. Miller, Pittsburg, Pa.

454 178. Motor Car for Underground Electric Systems. John J. Miller, Pittsburg, Pa.

454,181. Connector for Electric Wires. Edmund L. Nash, George G. Stout and Jesse R. Davis, Parkersburg, W.Va.

454,184. Electric Head Light, Richard Pattison and Dennis G. Desmond, Boston, Mass.

454,187. Secondary Battery. John S. Sellon, London, England.

454,207. Electric Resistance Box. Rudolf Eickemeyer, Jr., Yonkers, N. Y.

454,226. Wall Fixtures for Electrical Conductors. Oscar H. Pieper and Frank M. Watson, San Jose, Cal.

454,238. Electric Pole in Gas or Vapor Explosive Engines Frank E. Tremper and John W. Eisenhuth, San Francisco, Cal.

454,245. Signal Indicating Apparatus. J. O. Ziegler, Boston, Mass.

454,253. Electric Arc Lamp. Powhatan Clarke, Baltimore, Md.

This device may be placed upon a stand or platform, may be hung or suspended upside down, may be fixed horizontally to a wall, and the carbons may be operated both together or one only, while the other is fixed, and may work perpendicularly as well as horizontally.

454,262. Incandescent Lamp Filament. Thomas A. Edison, Llewellyn Park, N. J.

454 270. Electric Current Indicator. Albert B. Herrick, New York, N. Y.

454,275. Tubular Electric Conduit. Edward H. Johnson, New York N. Y.

The last claim reads:

'3. A compound tube comprising a series of lengths of tubing slipped in another series of lengths of tubing larger in diameter, so as to break joint therewith, a cementing material binding the two series of tubing together, and a collar for the joints of the outer series of tubing."

454,294. Electric Arc Lamp. Samuel W. Rushmore, Brooklyn, N. Y.

454,295. Electric Arc Lamp. Samuel W. Rushmore, Brooklyn, N. Y.

Of the nine claims the sixth is given:

"A clutch for arc lamp carbons, consisting of a swinging frame, a roller journaled to the frame, a second roller carried by an arm pivoted to the frame, means for moving the arm to force the roller against the carbon, and a stop for said arm."

454,313. Electric Apparatus for Treating Deafness. George F. Webb, Jefferson, O.

454,336. Dynamo Electric Machine. Rudolf Eickemeyer, Yonkers, N. Y.

454,338. Electric Telegraphic Apparatus. Samuel B. V. Essick, Brooklyn, N. Y,

Claim four reads:

"An electro magnetic pole changer having a pair of coils in a main line circuit, a second coil in a local circuit, and a pair of pole changing arms carried by a pivoted core polarized by the local coil."

454,344. Electric Block System for Railways. Augustus H R. Guiley, South Easton, Pa.

454,381. Process of Electro Deposition and Cathode Therefor. Alexander C. Reinfeld, Vienna, Austria-Hungary.

454,404. Apparatus for Sewing Carpets. Franklin Ames, Chicago, Ill.

454,430. Method of Making Binding Posts. Edward T. Greenfield, New York, N. Y.

454,437. Current Collecting Device. Rudolph M. Hunter, Philadelphia, Pa.

454,443. Electric Arc Lamp. John E. McAuley, Chicago, Ill.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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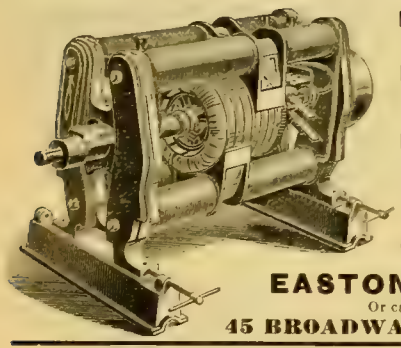

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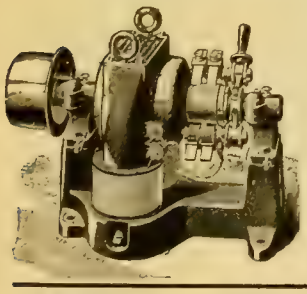

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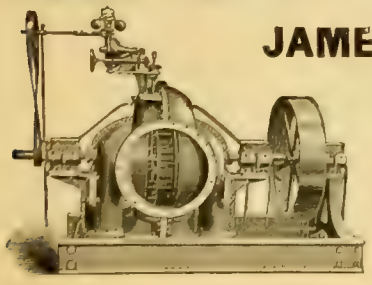

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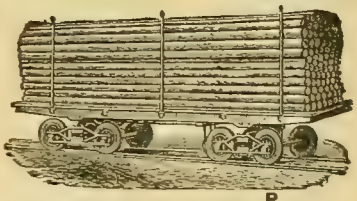

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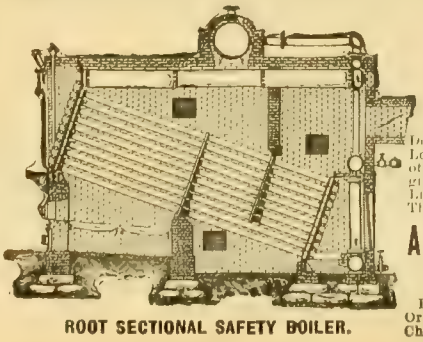

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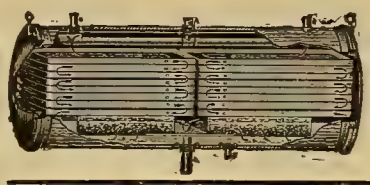

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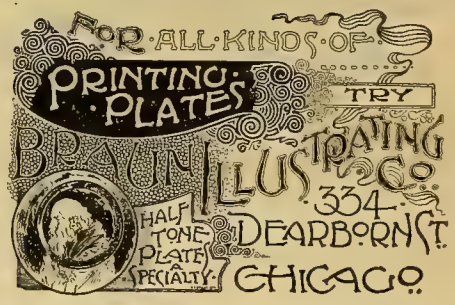

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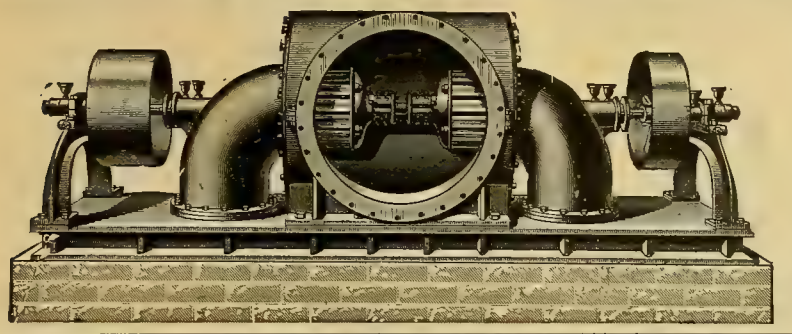

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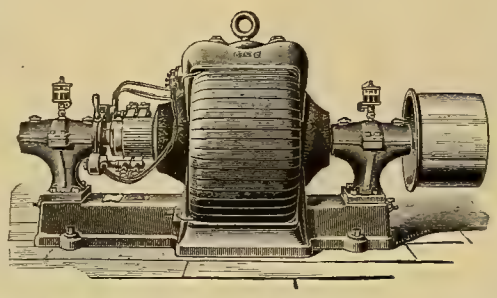

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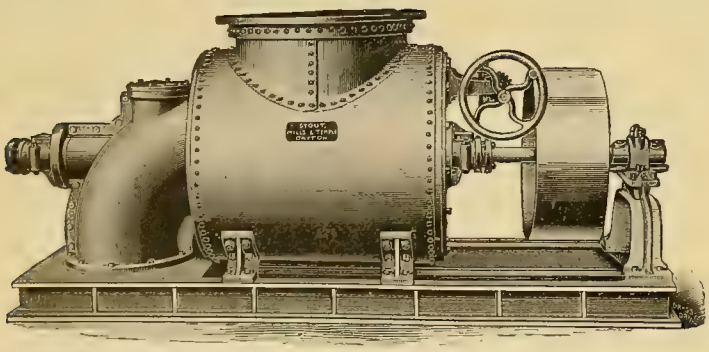

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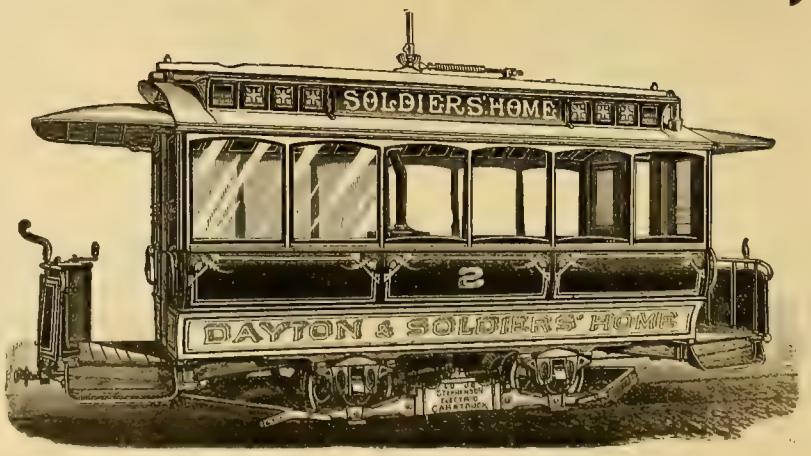

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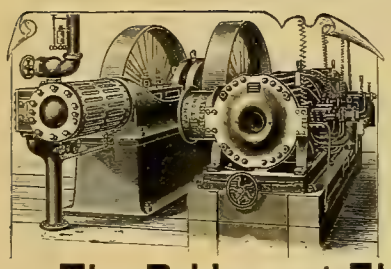
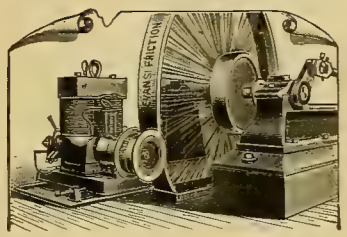

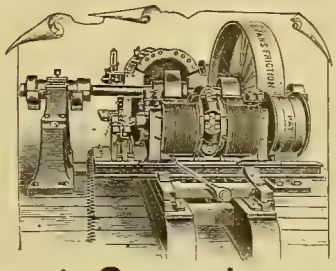

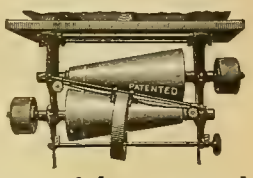

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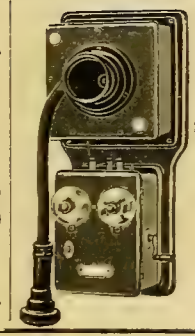

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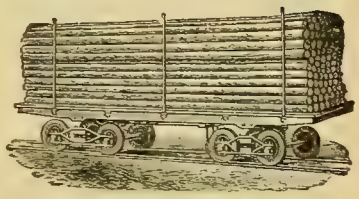

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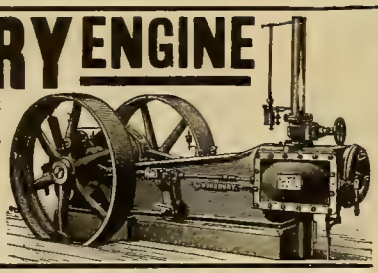

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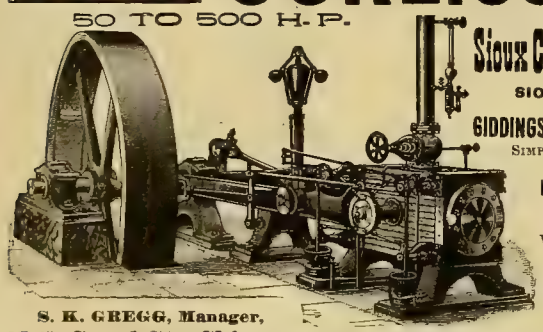

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The ordinary Steam Engine requires constant attention, largely from two causes: 1st. Because its design (not admitting of self-lubrication) must have all parts lubricated by hand many times daily; 2d. Because the DOUBLE-ACTING principle MUST loosen the parts. This is only a question of time. If the Engine be well built, more time; if carelessly built, less time; the result, however, is inevitable. It is a question of principle and not of workmanship. Imagine the shock produced by reversing the full power at every stroke. Just think how this shock is aggravated when the Engine is speeded up! The blow is equal to that of a steam hammer, and MUST loosen the parts.

The low initial speed of the ordinary Engine necessitates "speeding-up," as it is called, in driving all machinery that runs even at ordinary speeds. This "speeding-up" process involves an outlay for shafting, hangers, pulleys, belting, etc., often equal to the cost of the Engine itself! It costs at least $5.00 per year to lubricate each additional bearing. It costs the fuel necessary to drive all this useless, expensive and non-productive machinery, bought and run for the sole purpose of obtaining requisite speeds.

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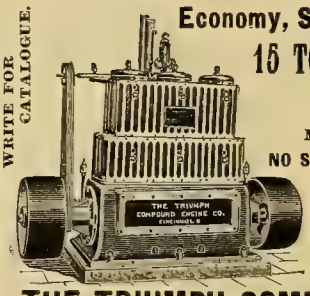

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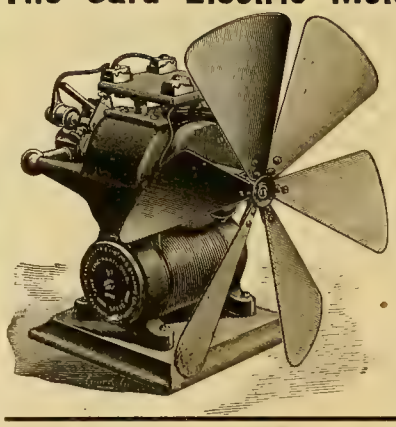

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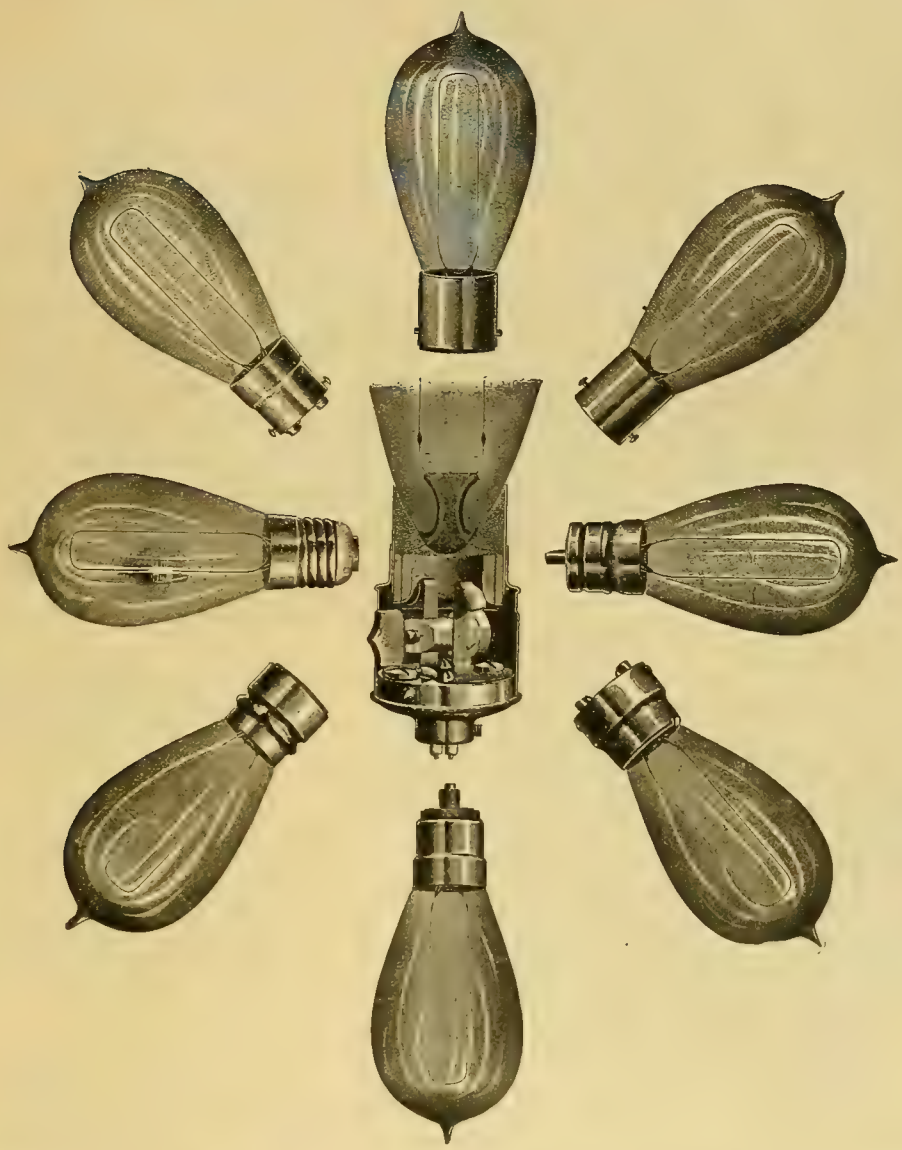

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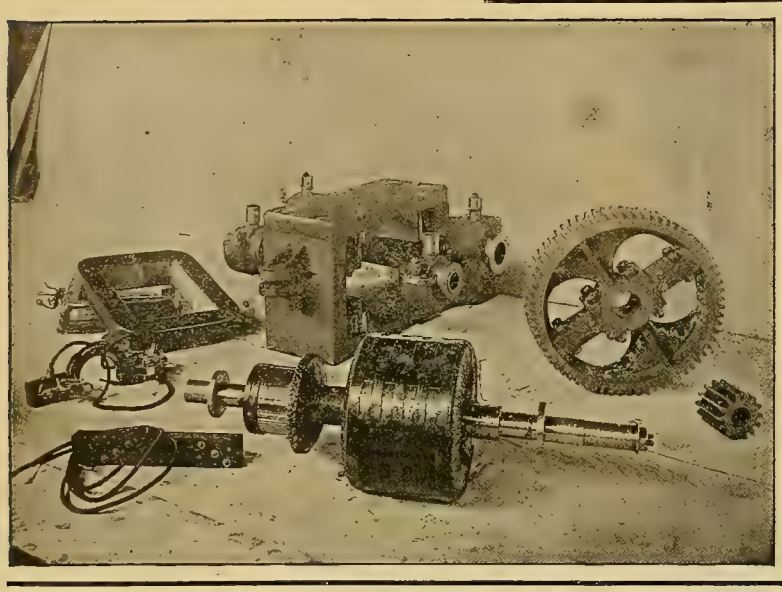

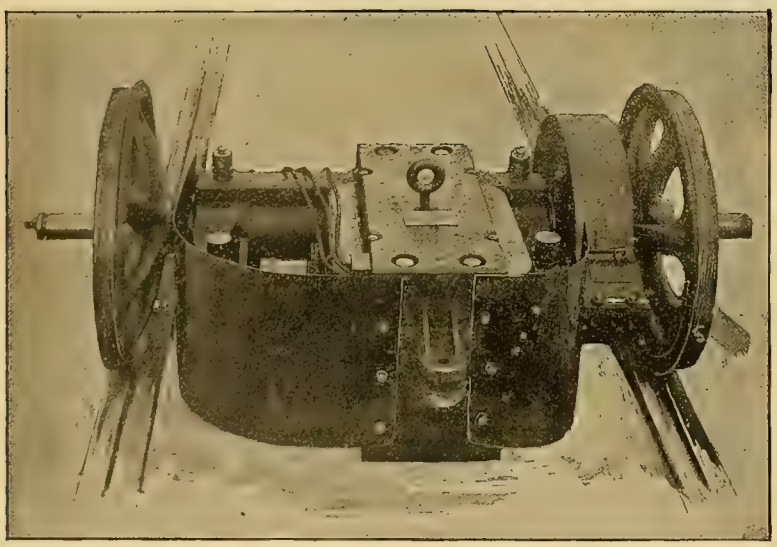

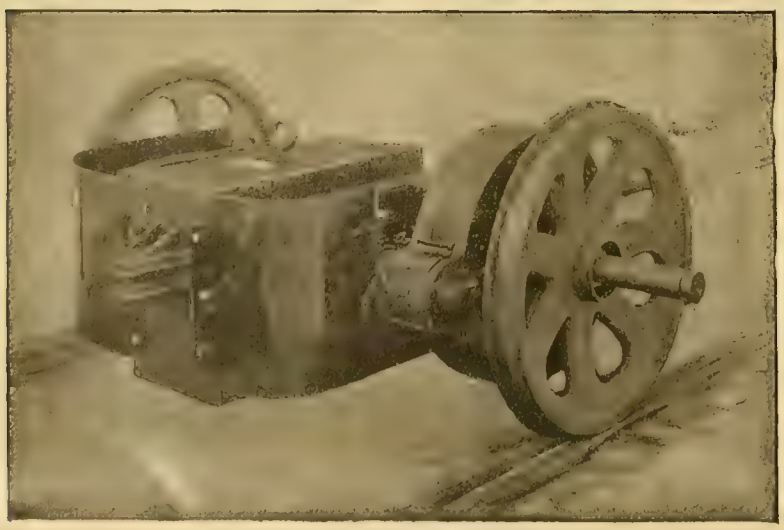

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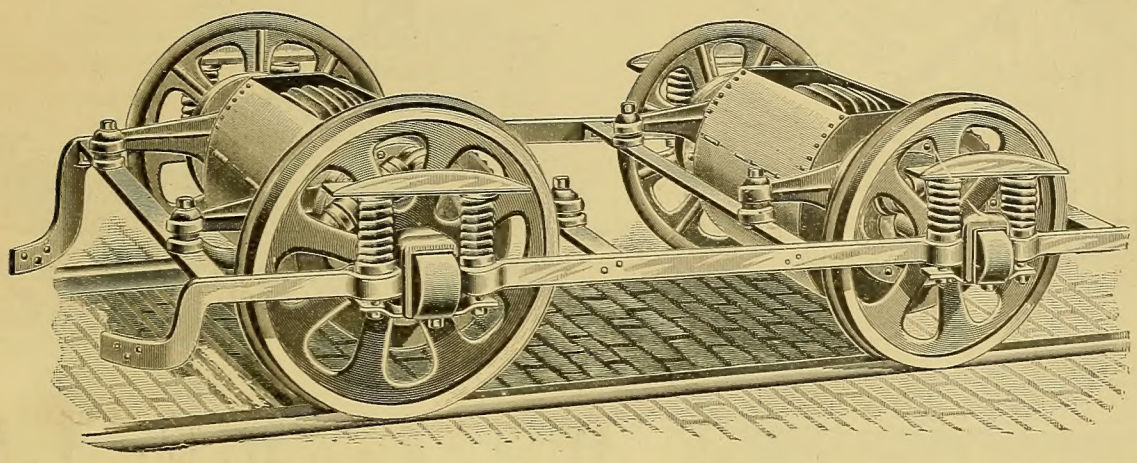

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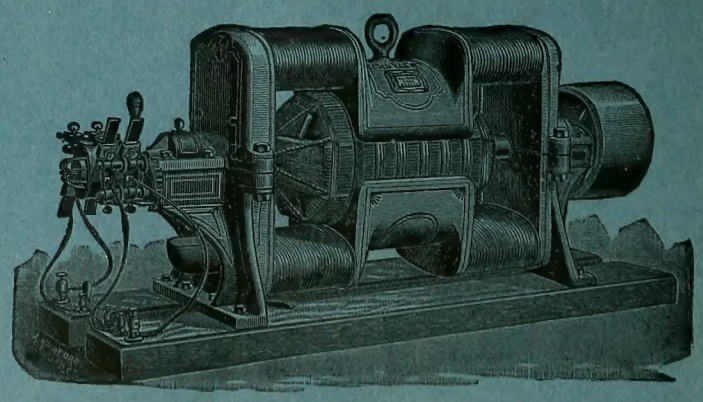

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